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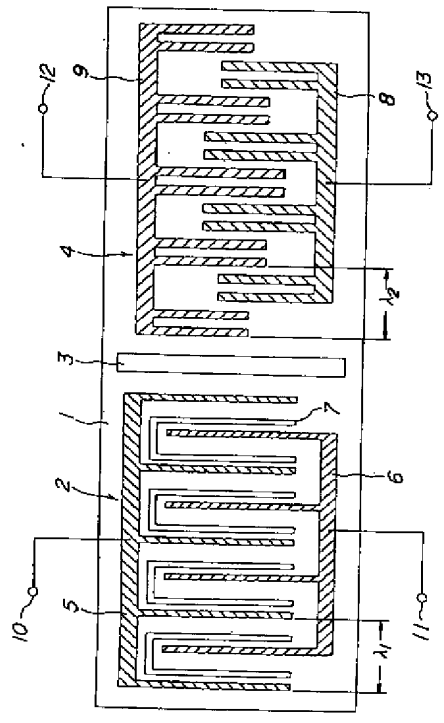
(54)【発明の名称】　弾性表面波フィルタ装置及びこれに用いる変換器

(57)【要約】
【課題】　弾性表面波フィルタ装置の通過特性の波形が対称となるとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適なものとする。
【解決手段】　入力側変換器２で励振される基本弾性表面波の波長をλ_1とし、出力側変換器４で励起される基本弾性表面波の波長をλ_2とする場合、入力側変換器２で励振される弾性表面波の中心周波数が、出力側変換器４で励起される弾性表面波の中心周波数と一致するように、$\lambda_1 \neq \lambda_2$となるよう弾性表面波フィルタ装置を構成する。



【特許請求の範囲】

【請求項１】圧電性基板と、この圧電性基板上に形成した入力側変換器と、この入力側変換器で励振された弾性表面波を変換する出力側変換器とを具える弾性表面波フィルタ装置において、前記入力側変換器又は出力側変換器のうちのいずれか一方を一方向性変換器で構成し、他方を双方向性変換器で構成し、λ_1 を前記一方向性変換器で励振される基本弾性表面波の伝播波長とするとともにλ_2 を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合、$\lambda_1 \neq \lambda_2$ となるように構成したことを特徴とする弾性表面波フィルタ装置。

【請求項２】前記一方向性変換器が、λ_1 を前記一方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、λ_1 のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ_1 ／１２の複数の電極指を有する正電極と、同様にλ_1 のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ_1 ／１２の電極指を有し、各電極指が前記正電極の電極指とλ_1 ／２の中心間距離を以てそれぞれ位置する負電極と、前記正電極の電極指と負電極の電極指との間に配置され、弾性表面波の伝播方向の幅がほぼλ_1 ／１２の電極指を有し、各電極指が、隣接する正電極の電極指と負電極の電極指との間の中間位置から弾性表面波の伝播方向又はこれとは反対の方向にλ_1 ／１２偏位して位置する短絡型浮き電極とを具え、前記双方向性変換器が、λ_2 を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、λ_2 ／４の中心間距離を以て配置し、弾性表面波の伝播方向の幅がλ_2 ／８である２個の電極指の組をλ_2 のピッチで周期的に形成した正電極と、同様にλ_2 ／４の中心間距離を以て位置し、弾性表面波の伝播方向の幅がλ_2 ／８である２個の電極指の組をλのピッチで周期的に形成され、各電極指の組が前記正電極の隣接する電極指の組とλ_2 ／２の中心間距離を以てそれぞれ位置する負電極とを具えることを特徴とする請求項１記載の弾性表面波フィルタ装置。

【請求項３】前記一方向性変換器が、λ_1 を前記一方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、弾性表面波の伝播方向における幅がλ_1／８及び３λ_1 ／８の電極指が３λ_1 ／８の中心間距離を以て位置する電極指の組を、λ_1 のピッチで周期的に形成した第１の電極と、弾性表面波の伝播方向における幅がλ_1 ／８の複数の電極指を、隣接する前記電極指の組とそれぞれλ_1／２の距離を以て位置するようにλ_1 のピッチで周期的に形成した、第２の電極とを具え、前記双方向性変換器が、λ_2 を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、λ_2 ／４の中心間距離を以て配置し、弾性表面波の伝播方向の幅がλ_2 ／８である２個の電極指の組をλのピッチで周期的に形成され、各電極指の組が前記正電極の隣接する電極指の組とλ／２の中心間距離を以てそれぞれ位置する負電極とを具えることを特徴とする請求項１記載の弾性表面波フィルタ装置。

【請求項４】前記一方向性変換器を正規型電極構造とし、前記双方向性変換器を、重み付けした電極構造としたことを特徴とする請求項１から３のうちのいずれかに記載の弾性表面波フィルタ装置。

【請求項５】前記双方向性変換器の重み付け電極構造が、各電極指の弾性表面波の伝播方向と直交する方向の長さが弾性表面波伝播方向に沿って順次変化するアポタイズ法により構成されていることを特徴とする請求項４記載の弾性表面波フィルタ装置。

【請求項６】前記圧電性基板を、水晶基板、タンタル酸リチウム基板又はほう酸リチウム基板としたことを特徴とする請求項１から５のうちのいずれかに記載の弾性表面波フィルタ装置。

【請求項７】圧電性基板と、この圧電性基板上に形成された双方向性変換器と、この双方向性変換器の弾性表面波の伝播軸線の両側にそれぞれ配置した第１及び第２の一方向性変換器とを具え、前記双方向性変換器を入力側変換器とした場合に前記第１及び第２の一方向性変換器を出力側変換器とし、前記双方向性変換器を出力側変換器とした場合に前記第１及び第２の一方向性変換器を入力側変換器とし、λ_3 を前記一方向性変換器で励振される基本弾性表面波の伝播波長とするとともにλ_4 を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合、$\lambda_3 \neq \lambda_4$ となるように構成したことを特徴とする弾性表面波フィルタ装置。

【請求項８】前記第１及び第２の一方向性変換器が、λ_3 を前記一方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、λ_3 のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ_3 ／１２の複数の電極指を有する正電極と、同様にλのピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ_3 ／１２の電極指を有し、各電極指が前記正電極の電極指とλ_3 ／２の中心間距離を以てそれぞれ位置する負電極と、前記正電極の電極指と負電極の電極指との間に配置され、弾性表面波の伝播方向の幅がほぼλ_3 ／１２の電極指を有し、各電極指が、隣接する正電極の電極指と負電極の電極指との間の中間位置から弾性表面波の伝播方向又はこれとは反対の方向にλ_3 ／１２偏位して位置する短絡型浮き電極とを具え、前記双方向性変換器が、λ_4 を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、λ_4 ／４の中心間距離を以て配置し、弾性表面波の伝播方向の幅がλ_4 ／８である２個の電極指の組をλ_4 のピッチで周期的に形成した正電極と、同様にλ_4 ／４の中心間距離を以て位置し、弾性表面波の伝播方向の幅がλ_4 ／８である２個の電極指の組をλ_4 のピッチで周期的に形成され、各電極指の組が前記正電極の隣接する電極指の組とλ_4 ／２の中心間距離を以てそれぞれ位置する負電極とを具えることを特徴と

する請求項７記載の弾性表面波フィルタ装置。

【請求項９】前記第１及び第２の一方向性変換器が、λ_3 を前記一方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、弾性表面波の伝播方向における幅がλ_1 ／８及び３λ_3 ／８の電極指が３λ_3 ／８の中心間距離を以て位置する電極指の組を、λ_3 のピッチで周期的に形成した第１の電極と、弾性表面波の伝播方向における幅がλ_3 ／８の複数の電極指を、隣接する前記電極指の組とそれぞれλ_3 ／２の距離を以て位置するようにλ_3 のピッチで周期的に形成した、第２の電極とを具え、前記双方向性変換器が、λ_4 を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、λ_4 ／４の中心間距離を以て配置し、弾性表面波の伝播方向の幅がλ_4 ／８である２個の電極指の組をλ_4 のピッチで周期的に形成した正電極と、同様にλ_4 ／４の中心間距離を以て位置し、弾性表面波の伝播方向の幅がλ_4 ／８である２個の電極指の組をλ_4 のピッチで周期的に形成され、各電極指の組が前記正電極の隣接する電極指の組とλ_4 ／２の中心間距離を以てそれぞれ位置する負電極とを具えることを特徴とする請求項７記載の弾性表面波フィルタ装置。

【請求項１０】前記一方向性変換器を正規型電極構造とし、前記双方向性変換器を、重み付けした電極構造としたことを特徴とする請求項７から９のうちのいずれかに記載の弾性表面波フィルタ装置。

【請求項１１】前記双方向性変換器の重み付け電極構造が、各電極指の弾性表面波の伝播方向と直交する方向の長さが弾性表面波伝播方向に沿って順次変化するアポタイズ法により構成されていることを特徴とする請求項１０記載の弾性表面波フィルタ装置。

【請求項１２】前記圧電性基板を、水晶基板、タンタル酸リチウム基板又はほう酸リチウム基板としたことを特徴とする請求項８から１１のうちのいずれかに記載の弾性表面波フィルタ装置。

【請求項１３】弾性表面波フィルタ装置用の変換器であって、圧電性基板と、この圧電性基板上に形成され、弾性表面波の伝播軸線の両方向に弾性表面波を励振する双方向性電極構造を有する双方向性変換器部分と、弾性表面波の伝播方向の一方の方向だけ弾性表面波を励振する一方向性電極構造を有する一方向性変換器部分とを具え、これら双方向性変換器部分と一方向性変換器部分とを、これら変換器部分の伝播軸線が互いに一致するように一体的に結合し、λ_5 を前記一方向性変換器で励振される基本弾性表面波の伝播波長とするとともにλ_6 を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合、$\lambda_5 \neq \lambda_6$ となるように構成したことを特徴とする変換器。

【請求項１４】前記一方向性変換器部分が、λ_5 を前記一方向性変換器部分で励振される基本弾性表面波の伝播波長とした場合に、λ_5 のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ_5 ／１２の複数の電極指を有する正電極と、同様にλ_5 のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ_5 ／１２の電極指を有し、各電極指が前記正電極の電極指とλ_5 ／２の中心間距離を以てそれぞれ位置する負電極と、前記正電極の電極指と負電極の電極指との間に配置され、弾性表面波の伝播方向の幅がほぼλ_5 ／１２の電極指を有し、各電極指が、隣接する正電極の電極指と負電極の電極指との間の中間位置から弾性表面波の伝播方向又はこれとは反対の方向にλ_5 ／１２偏位して位置する短絡型浮き電極とを具え、前記双方向性変換器部分が、λ_6 を前記双方向性変換器部分で励振される基本弾性表面波の伝播波長とした場合に、λ_6 ／４の中心間距離を以て配置し、弾性表面波の伝播方向の幅がλ_6 ／８である２個の電極指の組をλ_6 のピッチで周期的に形成した正電極と、同様にλ_6 ／４の中心間距離を以て位置し、弾性表面波の伝播方向の幅がλ_6 ／８である２個の電極指の組をλ_6 のピッチで周期的に形成され、各電極指の組が前記正電極の隣接する電極指の組とλ_6 ／２の中心間距離を以てそれぞれ位置する負電極とを具えることを特徴とする請求項１３記載の変換器。

【請求項１５】前記一方向性変換器部分及び双方向性変換器部分が、各電極指の弾性表面波の伝播方向と直交する方向の長さが弾性表面波の伝播方向に沿って順次変化するように重み付けしたことを特徴とする請求項１３又は１４記載の変換器。

【請求項１６】前記一方向性変換器部分の電極指の弾性表面波の伝播方向と直交する方向の長さが、前記双方向性変換器部分の電極指の弾性表面波の伝播方向と直交する方向の最大長より長いことを特徴とする請求項１５記載の変換器。

【請求項１７】前記圧電性基板を、水晶基板、タンタル酸リチウム基板又はほう酸リチウム基板としたことを特徴とする請求項１３から１６のうちのいずれかに記載の変換器。

【請求項１８】圧電性基板と、この圧電性基板上に形成した入力側変換器と、この入力側変換器で励振された弾性表面波を変換する出力側変換器とを具え、前記入力側変換器又は出力側変換器のうちのいずれかの変換器を、弾性表面波の伝播軸線の一方の方向だけ弾性表面波を励振する一方向性変換器で構成し、他の変換器を、弾性表面波の伝播軸線の両方向に弾性表面波を励振する双方向性電極構造を有する双方向性変換器部分と、弾性表面波の伝播方向の一方の方向だけ弾性表面波を励振する一方向性電極構造を有する一方向性変換器部分とを具え、これら双方向性変換器部分と一方向性変換器部分とを、これら変換器部分の伝播軸線が互いに一致するように一体的に結合された変換器で構成し、λ_7 を前記一方向性変換器及び一方向性変換器部分で励起される基本弾性表面波の伝播波長とするとともにλ_8 を前記双方向性変換器

部分で励起される基本弾性表面波の伝播波長とした場合、$\lambda_7 \neq \lambda_8$ となるように構成したことを特徴とする弾性表面波フィルタ装置。

【請求項１９】前記一方向性変換器及び前記一方向性変換器部分が、λ_7 を前記一方向性変換器及び前記一方向性変換器部分で励振される基本弾性表面波の伝播波長とした場合に、λ_7 のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ_7 ／１２の電極指を有する正電極と、同様にλ_7 のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ_7 ／１２の電極指を有し、各電極指が前記正電極の電極指とλ_7 ／２の中心間距離を以てそれぞれ位置する負電極と、前記正電極の電極指と負電極の電極指との間に配置され、弾性表面波の伝播方向の幅がほぼλ_7 ／１２の電極指を有し、各電極指が、隣接する正電極の電極指と負電極の電極指との間の中間位置から弾性表面波の伝播方向又はこれとは反対の方向にλ_7 ／１２偏位して位置する短絡型浮き電極とを具え、前記双方向性変換器部分が、λ_8 を前記双方向性変換器部分で励振される基本弾性表面波の伝播波長とした場合に、λ_8 ／４の中心間距離を以て配置し、弾性表面波の伝播方向の幅がλ_8 ／８である２個の電極指の組をλ_8 のピッチで周期的に形成した正電極と、同様にλ_8 ／４の中心間距離を以て位置し、弾性表面波の伝播方向の幅がλ_8 ／８である２個の電極指の組をλ_8 のピッチで周期的に形成され、各電極指の組が前記正電極の隣接する電極指の組とλ_8 ／２の中心間距離を以てそれぞれ位置する負電極とを具えることを特徴とする請求項１８記載の弾性表面波フィルタ装置。

【請求項２０】前記一方向性変換器部分及び双方向性変換器部分が、各電極指の弾性表面波の伝播方向と直交する方向の長さが弾性表面波の伝播方向に沿って順次変化するように重み付けしたことを特徴とする請求項１８又は１９記載の弾性表面波フィルタ装置。

【請求項２１】前記一方向性変換器部分の電極指の弾性表面波の伝播方向と直交する方向の長さが、前記双方向性変換器部分の電極指の弾性表面波の伝播方向と直交する方向の最大長よりも長いことを特徴とする請求項２０記載の弾性表面波フィルタ装置。

【請求項２２】前記圧電性基板を、水晶基板、タンタル酸リチウム基板又はほう酸リチウム基板としたことを特徴とする請求項１８から２１のうちのいずれかに記載の弾性表面波フィルタ装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は弾性表面波フィルタ装置、特にＣＤＭＡ通信方式に好適な弾性表面波フィルタ装置に関するものである。さらに、本発明は上記弾性表面波フィルタ装置に好適な変換器に関するものである。

【０００２】

【従来の技術】デジタル通信システムの開発に伴い、種々の通信方式が提案されている。このような通信方法としては、例えば、ＦＤＭＡ（周波数分割多元接続）方式及びＴＤＭＡ（時分割多元接続）方式がある。ＦＤＭＡ方式では、周波数帯域を分割してこれらを各無線局に割り当てており、それに対してＴＤＭＡ方式では、時間帯域を分割してこれらを各無線局に割り当てている。

【０００３】また、ＣＤＭＡ（符号分割多元接続）方式が近年提案されている。このＣＤＭＡ方式では、周波数及び時間で重畳された信号を利用することによりチャネル数を多数確保することができるため高い有用性があり、その開発が強く要請されている。このＣＤＭＡ方式に用いられる弾性表面波フィルタ装置については特有のフィルタ特性が要求されており、その特性を要約すると次のようになる。

（１）１０ｄＢ以下の挿入損失を満足すること。

（２）位相歪みの小さい周波数特性を獲得できること。

（３）３０ｄＢ以上のＴ．Ｔ．Ｅ．(triple Transit Echo) 減衰レベルを満足すること。

【０００４】これら特性を満足するために、本発明者による特開平第8-213870号公報に開示された弾性表面波フィルタ装置は、入力側変換器又は出力側変換器のうちの一方を一方向性変換器で構成するとともに、他方を双方向性変換器で構成している。このように、アポタイズ電極構造を有する双方向性変換器と、励振効果及び反射効果を利用する一方向性変換器を適切に組み合わすことにより、周波数特性については双方向性変換器の特性が活用され、挿入損失及びＴ．Ｔ．Ｅ．減衰レベルについては、一方向性変換器の特性が活用され、その結果、挿入損失、Ｔ．Ｔ．Ｅ．減衰レベル及び周波数特性の全てを満足する弾性表面波フィルタ装置を実現することができる。

【０００５】

【発明が解決しようとする課題】このような弾性表面波フィルタ装置では、弾性表面波フィルタ装置の通過特性の波形が非対称になるとともに帯域外スプリアスを有効に低減できず、これは弾性表面波フィルタ装置にとって好ましくない。また、このような弾性表面波フィルタ装置では、周波数特性が急峻な弾性表面波フィルタ装置を設計するに当たっても好ましくない。

【０００６】本発明の第１の目的は、入力側変換器又は出力側変換器のうちのいずれか一方を一方向性変換器で構成し、他方を双方向性変換器で構成した弾性表面波フィルタ装置において、弾性表面波の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適な弾性表面波フィルタ装置を提供することである。

【０００７】本発明の第２の目的は、双方向性変換器の弾性表面波の伝播軸線の両側に第１及び第２の一方向性

変換器をそれぞれ配置した弾性表面波フィルタ装置において、弾性表面波の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適な弾性表面波フィルタ装置を提供することである。

【０００８】本発明の第３の目的は、弾性表面波の伝播軸線の両方向に弾性表面波を励振する双方向性電極構造を有する双方向性変換器部分と、弾性表面波の伝播方向の一方の方向だけ弾性表面波を励振する一方向性電極構造を有する一方向性変換器部分とを具える変換器において、弾性表面波の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適な変換器を提供することである。

【０００９】本発明の第４の目的は、弾性表面波の伝播軸線の両方向に弾性表面波を励振する双方向性電極構造を有する双方向性変換器部分及び弾性表面波の伝播方向の一方の方向だけ弾性表面波を励振する一方向性電極構造を有する一方向性変換器部分とを有する変換器と、一方向性変換器とを具える弾性表面波フィルタ装置において、弾性表面波の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適な弾性表面波フィルタ装置を提供することである。

【００１０】

【課題を解決するための手段】本発明による請求項１記載の弾性表面波フィルタ装置は、圧電性基板と、この圧電性基板上に形成した入力側変換器と、この入力側変換器で励振された弾性表面波を変換する出力側変換器とを具える弾性表面波フィルタ装置において、前記入力側変換器又は出力側変換器のうちのいずれか一方を一方向性変換器で構成し、他方を双方向性変換器で構成し、λ_1を前記一方向性変換器で励振される基本弾性表面波の伝播波長とするとともにλ_2を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合、$\lambda_1 \neq \lambda_2$となるように構成したことを特徴とするものである。

【００１１】上記弾性表面波経装置の通過特性の波形が非対称となるとともに帯域外スプリアスを有効に低減できない理由を本発明者が検討した結果、上記弾性表面波フィルタ装置では、一方向性変換器で励振される弾性表面波の伝播速度と双方向性変換器で励振される弾性表面波の伝播速度が相違するために、これらの変換器の中心周波数がずれるからであることが確認された。

【００１２】従来既知のように、基本弾性表面波の伝播速度、波長及び中心周波数をＶ，λ及びｆとすると、

【数１】$V = f\lambda$

の関係がある。したがって、一方向性変換器の電極指のピッチ及び双方向性変換器の電極指のピッチを共にλとした場合、すなわち一方向性変換器で励振される弾性表面波の波長と双方向性変換器で励起される弾性表面波の波長とが同一である場合、一方向性変換器で励振される弾性表面波の速度が双方向性変換器で励振される弾性表面波の速度と異なると、一方向性変換器で励振される弾性表面波の中心周波数が、双方向性変換器で励振される弾性表面波の中心周波数とずれるようになる。

【００１３】上記弾性表面波フィルタ装置において一方向性変換器で励振される弾性表面波の速度が双方向性変換器で励振される弾性表面波の速度と異なる理由を本発明者が検討した結果、圧電性基板の表面区域のうちの電極指が設けられた部分と圧電性基板の表面区域のうちの電極指が設けられていない部分とでは、弾性表面波の伝播速度が相違し、これら速度が相違するようになるためであることを確認した。すなわち、圧電性基板の表面区域のうちの電極指が設けられた部分を伝播する弾性表面波の速度が、圧電性基板の表面区域のうちの電極指が設けられていない部分を伝播する弾性表面波の速度よりも遅い。したがって、弾性表面波の伝播方向における、圧電性基板の表面区域全体に対する圧電性基板の表面区域のうちの電極指が設けられている部分の割合が大きくなるに従って、変換器を伝播する弾性表面波の速度が遅くなる。

【００１４】上記弾性表面波フィルタ装置では、弾性表面波の伝播方向における、圧電性基板の表面区域全体に対する圧電性基板の表面区域のうちの電極指が設けられている部分の割合は、一方向性変換器側と双方向性変換器側とでは相違する。例えば、一方向性変換器として浮き電極型の変換器を用いるとともに双方向性変換器としてアポタイズ型の変換器を用いる場合には、通常一方向性変換器の電極指幅を全てλ／１２とするとともに双方向性変換器の電極指の幅を全てλ／８にする。したがって、１λ当たりの一方向性変換器の電極指幅の総和はλ／３となるのに対して、１λ当たりの双方向性変換器の電極指幅の総和はλ／２となり、双方向性変換器側の方が電極指幅の総和が広いので、双方向性変換器で励振される弾性表面波の伝播速度は一方向性変換器で励振される弾性表面波の伝播速度より遅くなる。

【００１５】本発明者は、上記課題を解決するために、すなわち一方向性変換器で励振される弾性表面波の中心周波数を双方向性変換器で励振される弾性表面波の中心周波数と一致させるためには、一方向性変換器で励振される基本弾性表面波の伝播波長λ_1が双方向性変換器で励振される基本弾性表面波の伝播波長λ_2と異なるようにする。更に詳しく説明すると、一方向性変換器を伝播する弾性表面波の伝播速度をｖ１とし、双方向性変換器を伝播する弾性表面波の伝播速度をｖ２とすると、一方向性変換器で励振される弾性表面波の中心周波数を、双方向性変換器で励振される弾性表面波の中心周波数と一致させるためには、数１からわかるように、一方向性変換器で励振される弾性表面波の波長λ_1と双方向性変換器で励振される弾性表面波の波長λ_2との間には、

【数２】$\lambda_1 = v1\lambda_2 / v2$
の関係を有するようにλ_1及びλ_2を設定する必要がある。
【００１６】このようにして、入力側変換器又は出力側変換器のうちのいずれか一方を一方向性変換器で構成し、他方を双方向性変換器で構成した弾性表面波フィルタ装置において、一方向性変換器で励振される弾性表面波の中心周波数と双方向性変換器で励振される弾性表面波の中心周波数とを一致させることができるので、従来の利点を維持しつつ、弾性表面波フィルタ装置の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適なものとなる。
【００１７】本発明による請求項２記載の弾性表面波フィルタ装置は、前記一方向性変換器が、λ_1を前記一方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、λ_1のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼ$\lambda_1/12$の複数の電極指を有する正電極と、同様にλ_1のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼ$\lambda_1/12$の電極指を有し、各電極指が前記正電極の電極指と$\lambda_1/2$の中心間距離を以てそれぞれ位置する負電極と、前記正電極の電極指と負電極の電極指との間に配置され、弾性表面波の伝播方向の幅がほぼ$\lambda_1/12$の電極指を有し、各電極指が、隣接する正電極の電極指と負電極の電極指との間の中間位置から弾性表面波の伝播方向又はこれとは反対の方向に$\lambda_1/12$偏位して位置する短絡型浮き電極とを具え、前記双方向性変換器が、λ_2を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、$\lambda_2/4$の中心間距離を以て配置し、弾性表面波の伝播方向の幅が$\lambda_2/8$である２個の電極指の組をλ_2のピッチで周期的に形成した正電極と、同様に$\lambda_2/4$の中心間距離を以て位置し、弾性表面波の伝播方向の幅が$\lambda_2/8$である２個の電極指の組をλのピッチで周期的に形成され、各電極指の組が前記正電極の隣接する電極指の組と$\lambda_2/2$の中心間距離を以てそれぞれ位置する負電極とを具えることを特徴とするものである。
【００１８】浮き電極型の一方向性変換器として、正電極、負電極及び浮き電極の各電極板の弾性表面波の伝播方向の幅を$\lambda_1/8$に設定した$\lambda_1/8$型の一方向性変換器と、各電極板の弾性表面波の伝播方向の幅を$\lambda_1/12$に設定した$\lambda_1/12$型の一方向性変換器とがある。$\lambda_1/8$型のの一方向性変換器の場合、浮き電極の電極指を偏位させることができる範囲が狭すぎ、すなわち正電極、負電極及び浮き電極の各電極の配列ピッチを電極指の幅（すなわち、$\lambda_1/8$）又はこれの整数倍に設定することができない。その結果、双方向性変換器と組み合わせた場合、浮き電極による反射効果が有効に活用できず、したがって、挿入損失及びＧ．Ｄ．Ｔ．の面から特性の改善を期待することができない。
【００１９】これに対して、正電極、負電極及び浮き電極の各電極指の幅を$\lambda_1/12$に設定した$\lambda_1/12$型の一方向性変換器の場合、各電極の全ての電極指を$\lambda_1/12$又はこれの整数倍の配列ピッチで形成することができ、浮き電極による反射効果を有効に活用することができる。その結果、双方向性変換器と組み合わせた場合、挿入損失、Ｇ．Ｄ．Ｔ．周波数特性及びＴ．Ｔ．Ｅ．の全てを満足しうる弾性表面波フィルタ装置を実現することができる。
【００２０】次に、双方向性変換器について検討する。双方向性変換器として、正電極及び負電極の各電極指の幅を$\lambda_2/4$に設定した変換器がある。この変換器は、励振効率の面からとらえると極めて有益である。しかしながら、電極指の各端間のピッチが$\lambda_2/4$となるため、電極指の各端縁で生じた反射波が互いに同相になり、その結果、１ｄＢ以上の大きなリップルが生じてしまう。したがって、一方向性変換器と組み合わせた場合、周波数特性を満足することができない。
【００２１】また、各電極指の幅を$\lambda_2/8$に規定した双方向性変換器の場合、電極指の面積が$\lambda_2/4$型よりも少なくなるため励振効率は$\lambda_2/4$型よりも低下する。また、電極指の端縁で生じる反射波の位相が相互にずれるため、周波数特性にリップルが生じる。したがって、一方向性変換器と組み合わせた場合、挿入損失及び周波数特性について満足できる特性を得ることができない。
【００２２】これに対して、幅が$\lambda_2/8$の２本の電極指を対とし、正電極及び負電極の電極指を２本の電極指対で構成した$\lambda_2/8$スプリット型の双方向性変換器の場合、電極指の面積は、$\lambda_2/4$型と同一であり、高い励振効率が得られる。また、電極指端縁で発生する反射波は、互いに位相が反転した反射波同士だけであるため、リップルのない極めて良好な周波数特性が得られる。
【００２３】したがって、この$\lambda_2/8$スプリット型の電極構造を有する双方向性変換器を$\lambda_1/12$型の一方向性変換器と組み合わせれば、挿入損失、周波数特性及びＴ．Ｔ．Ｅ．減衰レベルについて各変換器が有する固有の不都合が互いに補完され、その結果、優れた特性を有する弾性表面波フィルタ装置を実現することができる。
【００２４】本発明による請求項３記載の弾性表面波フィルタ装置は、前記一方向性変換器が、λ_1を前記一方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、弾性表面波の伝播方向における幅が$\lambda_1/8$及び$3\lambda_1/8$の電極指が$3\lambda_1/8$の中心間距離を以て位置する電極指の組を、λ_1のピッチで周期的に形成した第１の電極と、弾性表面波の伝播方向における幅が$\lambda_1/8$の複数の電極指を、隣接する前記電極指の組と

それぞれλ_1／２の距離を以て位置するようにλ_1のピッチで周期的に形成した、第２の電極とを具え、前記双方向性変換器が、λ_2を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、λ_2／４の中心間距離を以て配置し、弾性表面波の伝播方向の幅がλ_2／８である２個の電極指の組をλのピッチで周期的に形成され、各電極指の組が前記正電極の隣接する電極指の組とλ／２の中心間距離を以てそれぞれ位置する負電極とを具えることを特徴とするものである。

【００２５】このように、弾性表面波の伝播方向における幅がλ_1／８である電極指と弾性表面波の伝播方向における幅が$3\lambda_1$／８である電極指とを組み合わせる構成とすることにより、一方向性変換器に入射した弾性表面波は、それぞれの電極指のエッジでの音響インピーダンスの不整合により反射されるが、その合成ベクトルの位相は、電気的な反射波の位相と正反対となるので、合成反射波を零にすることができ、挿入損失を犠牲にすることなく反射波をなくすことができる。

【００２６】本発明による請求項４記載の弾性表面波フィルタ装置は、前記一方向性変換器を正規型電極構造とし、前記双方向性変換器を、重み付けした電極構造としたことを特徴とするものである。

【００２７】この場合、一方向性変換器は、各電極指の弾性表面波の伝播方向と直交する方向の寸法が同一に設定され、重み付けされていない電極構造である正規型電極構造を有し、それに対して、双方向性変換器は、重み付けした電極構造を有する。帯域外減衰特性を大きく設定するためには、変換器に重み付けを施す必要がある。ここで、一方向性変換器の電極構造に重み付けをすると周波数特性が悪化する。特に、短絡型浮き電極型の一方向性変換器を重み付け電極構造とすると、短絡型浮き電極の電極指を接続する接続部が励振領域内に位置するようになり、この部分で不所望な反射波が生じたり、励起された弾性表面波に伝播速度差が生じたりするので、強いリップルが生じる。このような認識に基づいて、一方向性変換器を正規型の電極構造とするとともに、双方向性変換器に重み付けを行う。このような構成にすることにより、リップルのない特性を得ることができる。

【００２８】本発明による請求項５記載の弾性表面波フィルタ装置は、前記双方向性変換器の重み付け電極構造が、各電極指の弾性表面波の伝播方向と直交する方向の長さが弾性表面波伝播方向に沿って順次変化するアポタイズ法により構成されていることを特徴とするものである。

【００２９】重み付けの方法として、電極指を所望のピッチで間引く間引き法やバリビッチ法が知られている。しかしながら、これらの方法では、電極指における反射波に位相ずれが生じ、これがリップルの原因となる。それに対して、アポタイズ法では、電極指の弾性表面波の伝播方向と直交する方向の長さを順次変化させているので、位相ずれによるリップルの発生を防止し、リップルのない周波数特性を得ることができる。

【００３０】本発明による請求項６記載の弾性表面波フィルタ装置は、前記圧電性基板を、水晶基板、タンタル酸リチウム基板又はほう酸リチウム基板としたことを特徴とするものである。

【００３１】弾性表面波フィルタ装置の圧電性基板としては、通常、ニオブ酸リチウム基板、水晶基板、タンタル酸リチウム基板、ほう酸リチウム基板等が用いられている。これら基板のうち、ニオブ酸リチウム基板は比較的大きな電気機械結合係数（K^2）を有するので、良好な変換特性が得られるという利点がある。しかしながら、温度特性に難点があるため、すなわち温度変化に対する帯域幅の変化が大きくなるという欠点があり、広帯域用のフィルタとしてだけ用いられてきた。このため、従来の狭帯域フィルタとしては共振型のフィルタ装置だけが用いられてきた。しかしながら、共振型のフィルタは、その構造からＧＤＴが大きい不具合が強く指摘されていた。それに対して、浮き電極型又はダート型の変換器を有する弾性表面波フィルタ装置は、電極の非対称構造を有効に利用しているため、挿入損失、ＧＤＴを大幅に低減することができる。したがって、非対称構造の内部反射型電極構造を温度特性に優れた圧電性基板に適用すれば、ＧＤＴ及び挿入損失に優れるとともに、温度変化に対する通常帯域の変化が極めて小さい弾性表面波フィルタ装置を実現することができ、したがって、狭帯域フィルタとして構成した場合でも、極めて良好なフィルタ特性を有する弾性表面波フィルタ装置を実現することができる。

【００３２】このような状況を考慮すると、本発明の弾性表面波フィルタ装置によれば、周波数に対する温度特性が極めて小さく、電気機械結合係数がニオブ酸リチウム基板に比べて１桁以上小さく、かつ、電極指による反射係数が短絡型浮き電極に対して正の反射係数を有する圧電性基板を用いる。本発明では、このような圧電性基板として、電気機械結合係数が０．１４％の水晶基板、電気機械結合係数が０．６４％のタンタル酸リチウム基板、又は電気機械結合係数が１．０％のほう酸リチウム基板を用いる。これら基板は温度変化に対する周波数変動が微小であるので、圧電性基板としてこれら基板のうちのいずれかを用いると、温度特性に対する通過周波数帯域の変化を微小範囲に維持することができる。しかしながら、水晶、タンタル酸リチウム及びほう酸リチウムは電気機械結合係数が小さいため、既存の変換器をそのまま形成すると、挿入損失の観点から実現することができない。

【００３３】本発明者が水晶基板、タンタル酸リチウム基板及びほう酸リチウム基板における挿入損失について詳細な検討を行った結果、浮き電極の反射係数の符号が挿入損失に大きく影響していることが判明した。水晶基

板、タンタル酸リチウム基板及びほう酸リチウム基板の場合、開放型浮き電極に比べて短絡型浮き電極の方が反射係数が大きい。したがって、浮き電極として短絡型浮き電極を用いるのが好適である。このように構成することにより、電気機械結合係数の小さい水晶基板を用いても挿入損失を極めて小さい範囲に抑制することができ、その結果、温度特性に優れるとともに低損失の広帯域弾性表面波フィルタ装置を実現することができる。また、一方向性変換器としてダート型電極構造の変換器を用いた場合でも、同様に温度特性に優れるとともに低損失の広帯域弾性表面波フィルタ装置を実現することができる。

【００３４】水晶基板は温度変化に対する周波数変動が微小であるので、圧電性基板として水晶基板を用いると、温度変化による通過周波数帯域の変化を微小範囲に維持することができる。しかしながら、水晶は電気機械結合が小さいため、既存の変換器をそのまま形成すると挿入損失の観点から実用化することができない。本発明者が水晶基板における挿入損失について詳細な検討を行った結果、浮き電極の反射係数の符号が挿入損失に強く影響していることが判明した。水晶基板の場合、開放型浮き電極に比べて短絡型浮き電極の方が反射係数が大きい。したがって、浮き電極として短絡型浮き電極を用いるのが好適である。このように構成することにより、電気機械結合係数の小さい水晶基板を用いても挿入損失を極めて小さい範囲に抑制することができ、その結果、温度特性に優れるとともに低損失の広帯域弾性表面波フィルタ装置を実現することができる。また、一方向性変換器としてダート型電極構造の変換器を用いた場合でも、同様に温度特性に優れるとともに低損失の広帯域弾性表面波フィルタ装置を実現することができる。

【００３５】なお、タンタル酸リチウム基板は、水晶基板とほぼ同様な電気機械結合係数及び反射特性を有するので、水晶基板と同様に用いることができる。また、ほう酸リチウム基板についてもさらに挿入損失を改善することができ、水晶基板と同様に用いることができる。

【００３６】本発明による請求項７記載の弾性表面波フィルタ装置は、圧電性基板と、この圧電性基板上に形成された双方向性変換器と、この双方向性変換器の弾性表面波の伝播軸線の両側にそれぞれ配置した第１及び第２の一方向性変換器とを具え、前記双方向性変換器を入力側変換器とした場合に前記第１及び第２の一方向性変換器を出力側変換器とし、前記双方向性変換器を出力側変換器とした場合に前記第１及び第２の一方向性変換器を入力側変換器とし、λ_3 を前記一方向性変換器で励振される基本弾性表面波の伝播波長とするとともにλ_4 を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合、$\lambda_3 \neq \lambda_4$ となるように構成したことを特徴とするものである。

【００３７】双方向性変換器の弾性表面波の伝播軸線の両側に第１及び第２の一方向性変換器をそれぞれ配置した弾性表面波フィルタ装置においても、上記理由により、第１及び第２の一方向性変換器で励起される弾性表面波の中心周波数と双方向性変換器で励起される弾性表面波の中心周波数を一致させることができるので、従来の利点を維持しつつ、弾性表面波フィルタ装置の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適なものとなる。

【００３８】本発明による請求項８記載の弾性表面波フィルタ装置は、前記第１及び第２の一方向性変換器が、λ_3 を前記一方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、λ_3 のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ_3 ／１２の複数の電極指を有する正電極と、同様にλのピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ_3 ／１２の電極指を有し、各電極指が前記正電極の電極指とλ_3 ／２の中心間距離を以てそれぞれ位置する負電極と、前記正電極の電極指と負電極の電極指との間に配置され、弾性表面波の伝播方向の幅がほぼλ_3 ／１２の電極指を有し、各電極指が、隣接する正電極の電極指と負電極の電極指との間の中間位置から弾性表面波の伝播方向又はこれとは反対の方向にλ_3 ／１２偏位して位置する短絡型浮き電極とを具え、前記双方向性変換器が、λ_4 を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、λ_4 ／４の中心間距離を以て配置し、弾性表面波の伝播方向の幅がλ_4 ／８である２個の電極指の組をλ_4 のピッチで周期的に形成した正電極と、同様にλ_4 ／４の中心間距離を以て位置し、弾性表面波の伝播方向の幅がλ_4 ／８である２個の電極指の組をλ_4 のピッチで周期的に形成され、各電極指の組が前記正電極の隣接する電極指の組とλ_4 ／２の中心間距離を以てそれぞれ位置する負電極とを具えることを特徴とするものである。

【００３９】この場合も、上記理由により、λ_4 ／８スプリット型の電極構造を有する双方向性変換器をλ_3 ／１２型の一方向性変換器と組み合わせれば、挿入損失、周波数特性及びＴ．Ｔ．Ｅ．減衰レベルについて各変換器が有する固有の不都合が互いに補完され、その結果、優れた特性を有する弾性表面波フィルタ装置を実現することができる。

【００４０】本発明による請求項９記載の弾性表面波フィルタ装置は、前記第１及び第２の一方向性変換器が、λ_3 を前記一方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、弾性表面波の伝播方向における幅がλ_1 ／８及び３λ_3 ／８の電極指が３λ_3 ／８の中心間距離を以て位置する電極指の組を、λ_3 のピッチで周期的に形成した第１の電極と、弾性表面波の伝播方向における幅がλ_3 ／８の複数の電極指を、隣接する前記電極指の組とそれぞれλ_3 ／２の距離を以て位置する

ようにλ$_3$ のピッチで周期的に形成した、第２の電極とを具え、前記双方向性変換器が、λ$_4$ を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、λ$_4$ ／４の中心間距離を以て配置し、弾性表面波の伝播方向の幅がλ$_4$ ／８である２個の電極指の組をλ$_4$ のピッチで周期的に形成した正電極と、同様にλ$_4$ ／４の中心間距離を以て位置し、弾性表面波の伝播方向の幅がλ$_4$ ／８である２個の電極指の組をλ$_4$ のピッチで周期的に形成され、各電極指の組が前記正電極の隣接する電極指の組とλ$_4$ ／２の中心間距離を以てそれぞれ位置する負電極とを具えることを特徴とするものである。

【００４１】このように、弾性表面波の伝播方向における幅がλ$_3$ ／８である電極指と弾性表面波の伝播方向における幅が３λ$_3$ ／８である電極指とを組み合わせる構成とすることにより、上記理由によって挿入損失を犠牲にすることなく反射波をなくすことができる。

【００４２】本発明による請求項１０記載の弾性表面波フィルタ装置は、前記一方向性変換器を正規型電極構造とし、前記双方向性変換器を、重み付けした電極構造としたことを特徴とするものである。

【００４３】上記理由により、一方向性変換器を正規型の電極構造とするとともに、双方向性変換器に重み付けを行うことにより、リップルのない特性を得ることができる。

【００４４】本発明による請求項１１記載の弾性表面波フィルタ装置は、前記双方向性変換器の重み付け電極構造が、各電極指の弾性表面波の伝播方向と直交する方向の長さが弾性表面波伝播方向に沿って順次変化するアポタイズ法により構成されていることを特徴とするものである。

【００４５】上記理由により、重み付けの方法としてアポタイズ法を用いることによって、位相ずれによるリップルの発生を防止し、リップルのない周波数特性を得ることができる。

【００４６】本発明による請求項１２記載の弾性表面波フィルタ装置は、前記圧電性基板を、水晶基板、タンタル酸リチウム基板又はほう酸リチウム基板としたことを特徴とするものである。

【００４７】上記理由により、圧電性基板として、水晶基板、タンタル酸リチウム基板又はほう酸リチウム基板を用いることによって、温度特性に優れるとともに、低損失の弾性表面波フィルタ装置を実現することができる。

【００４８】本発明による請求項１３記載の変換器は、弾性表面波フィルタ装置用の変換器であって、圧電性基板と、この圧電性基板上に形成され、弾性表面波の伝播軸線の両方向に弾性表面波を励振する双方向性電極構造を有する双方向性変換器部分と、弾性表面波の伝播方向の一方の方向だけ弾性表面波を励振する一方向性電極構造を有する一方向性変換器部分とを具え、これら双方向性変換器部分と一方向性変換器部分とを、これら変換器部分の伝播軸線が互いに一致するように一体的に結合し、λ$_5$ を前記一方向性変換器で励振される基本弾性表面波の伝播波長とするとともにλ$_6$ を前記双方向性変換器で励振される基本弾性表面波の伝播波長とした場合、λ$_5$ ≠λ$_6$ となるように構成したことを特徴とするものである。

【００４９】弾性表面波の伝播軸線の両方向に弾性表面波を励振する双方向性電極構造を有する双方向性変換器部分と、弾性表面波の伝播方向の一方の方向だけ弾性表面波を励振する一方向性電極構造を有する一方向性変換器部分とを具える変換器においても、上記理由により、一方向性変換器部分で励振される弾性表面波の中心周波数と双方向性変換器部分で励振される弾性表面波の中心周波数とを一致させることができるので、他の変換器と組み合わせ用いる場合にも、従来の利点を維持しつつ、弾性表面波フィルタ装置の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適なものとなる。

【００５０】本発明による請求項１４記載の変換器は、前記一方向性変換器部分が、λ$_5$ を前記一方向性変換器で励振される基本弾性表面波の伝播波長とした場合に、λ$_5$ のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ$_5$／１２の複数の電極指を有する正電極と、同様にλ$_5$ のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ$_5$ ／１２の電極指を有し、各電極指が前記正電極の電極指とλ$_5$ ／２の中心間距離を以てそれぞれ位置する負電極と、前記正電極の電極指と負電極の電極指との間に配置され、弾性表面波の伝播方向の幅がほぼλ$_5$ ／１２の電極指を有し、各電極指が、隣接する正電極の電極指と負電極の電極指との間の中間位置から弾性表面波の伝播方向又はこれとは反対の方向にλ$_5$ ／１２偏位して位置する短絡型浮き電極とを具え、前記双方向性変換器部分が、λ$_6$ を前記双方向性変換器部分で励振される基本弾性表面波の伝播波長とした場合に、λ$_6$ ／４の中心間距離を以て配置し、弾性表面波の伝播方向の幅がλ$_6$ ／８である２個の電極指の組をλ$_6$ のピッチで周期的に形成した正電極と、同様にλ$_6$ ／４の中心間距離を以て位置し、弾性表面波の伝播方向の幅がλ$_6$ ／８である２個の電極指の組をλ$_6$ のピッチで周期的に形成され、各電極指の組が前記正電極の隣接する電極指の組とλ$_6$ ／２の中心間距離を以てそれぞれ位置する負電極とを具えることを特徴とするものである。

【００５１】この場合も、上記理由により、λ$_6$ ／８スプリット型の電極構造を有する双方向性変換器部分をλ$_5$ ／１２型の一方向性変換器部分と組み合わせれば、挿入損失、周波数特性及びＴ．Ｔ．Ｅ．減衰レベルについて各変換器部分が有する固有の不都合が互いに補完さ

れ、その結果、優れた特性を有する変換器を実現することができる。

【００５２】本発明による請求項１５記載の変換器は、前記一方向性変換器部分及び双方向性変換器部分が、各電極指の弾性表面波の伝播方向と直交する方向の長さが弾性表面波の伝播方向に沿って順次変化するように重み付けしたことを特徴とするものである。

【００５３】上記理由により、一方向性変換器部分及び双方向性変換器部分に重み付けを行うことにより、リップルのない特性を得ることができる。

【００５４】本発明による請求項１６記載の変換器は、前記一方向性変換器部分の電極指の弾性表面波の伝播方向と直交する方向の長さが、前記双方向性変換器部分の電極指の弾性表面波の伝播方向と直交する方向の最大長より長いことを特徴とするものである。

【００５５】上記理由により、重み付けの方法としてアポタイズ法を用いることによって、位相ずれによるリップルの発生を防止し、リップルのない周波数特性を得ることができる。

【００５６】本発明による請求項１７記載の変換器は、前記圧電性基板を、水晶基板、タンタル酸リチウム基板又はほう酸リチウム基板としたことを特徴とするものである。

【００５７】上記理由により、圧電性基板として、水晶基板、タンタル酸リチウム基板又はほう酸リチウム基板を用いることによって、他の変換器と組み合わせて用いる場合、温度特性に優れるとともに、低損失の弾性表面波フィルタ装置を実現することができる。

【００５８】本発明による請求項１８記載の弾性表面波フィルタ装置は、圧電性基板と、この圧電性基板上に形成した入力側変換器と、この入力側変換器で励振された弾性表面波を変換する出力側変換器とを具え、前記入力側変換器又は出力側変換器のうちのいずれかの変換器を、弾性表面波の伝播軸線の一方の方向だけ弾性表面波を励振する一方向性変換器で構成し、他の変換器を、弾性表面波の伝播軸線の両方向に弾性表面波を励振する双方向性電極構造を有する双方向性変換器部分と、弾性表面波の伝播方向の一方の方向だけ弾性表面波を励振する一方向性電極構造を有する一方向性変換器部分とを具え、これら双方向性変換器部分と一方向性変換器部分とを、これら変換器部分の伝播軸線が互いに一致するように一体的に結合された変換器で構成し、λ_7 を前記一方向性変換器及び一方向性変換器部分で励振される基本弾性表面波の伝播波長とするとともにλ_8 を前記双方向性変換器部分で励振される基本弾性表面波の伝播波長とした場合、$\lambda_7 \neq \lambda_8$ となるように構成したことを特徴とするものである。

【００５９】弾性表面波の伝播軸線の両方向に弾性表面波を励振する双方向性電極構造を有する双方向性変換器部分及び弾性表面波の伝播方向の一方の方向だけ弾性表面波を励振する一方向性電極構造を有する一方向性変換器部分とを有する変換器と、一方向性変換器とを具える弾性表面波フィルタ装置において、上記理由により、一方向性変換器部分側及び一方向性変換器側で励振される弾性表面波の周波数と双方向性変換器側で励振される弾性表面波の中心周波数とを一致させることができるので、従来の利点を維持しつつ、弾性表面波フィルタ装置の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適なものとなる。

【００６０】本発明による請求項１９記載の弾性表面波フィルタ装置は、前記一方向性変換器及び前記一方向性変換器部分が、λ_7 を前記一方向性変換器及び前記一方向性変換器部分で励振される基本弾性表面波の伝播波長とした場合に、λ_7 のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ_7 ／１２の電極指を有する正電極と、同様にλ_7 のピッチで周期的に形成され、弾性表面波の伝播方向の幅がほぼλ_7 ／１２の電極指を有し、各電極指が前記正電極の電極指とλ_7 ／２の中心間距離を以てそれぞれ位置する負電極と、前記正電極の電極指と負電極の電極指との間に配置され、弾性表面波の伝播方向の幅がほぼλ_7 ／１２の電極指を有し、各電極指が、隣接する正電極の電極指と負電極の電極指との間の中間位置から弾性表面波の伝播方向又はこれとは反対の方向にλ_7 ／１２偏位して位置する短絡型浮き電極とを具え、前記双方向性変換器部分が、λ_8 を前記双方向性変換器部分で励振される基本弾性表面波の伝播波長とした場合に、λ_8 ／４の中心間距離を以て配置し、弾性表面波の伝播方向の幅がλ_8 ／８である２個の電極指の組をλ_8 のピッチで周期的に形成した正電極と、同様にλ_8 ／４の中心間距離を以て位置し、弾性表面波の伝播方向の幅がλ_8 ／８である２個の電極指の組をλ_8 のピッチで周期的に形成され、各電極指の組が前記正電極の隣接する電極指の組とλ_8 ／２の中心間距離を以てそれぞれ位置する負電極とを具えることを特徴とするものである。

【００６１】この場合も、上記理由により、λ_8 ／８スプリット型の電極構造を有する双方向性変換器をλ_7 ／１２型の一方向性変換器と組み合わせれば、挿入損失、周波数特性及びＴ．Ｔ．Ｅ．減衰レベルについて各変換器が有する固有の不都合が互いに補完され、その結果、優れた特性を有する弾性表面波フィルタ装置を実現することができる。

【００６２】本発明による請求項２０記載の弾性表面波フィルタ装置は、前記一方向性変換器部分及び双方向性変換器部分が、各電極指の弾性表面波の伝播方向と直交する方向の長さが弾性表面波の伝播方向に沿って順次変化するように重み付けしたことを特徴とするものである。

【００６３】上記理由により、一方向性変換器部分及び

双方向性変換器部分に重み付けを行うことにより、リップルのない特性を得ることができる。

【００６４】本発明による請求項２１記載の弾性表面波フィルタ装置は、前記一方向性変換器部分の電極指の弾性表面波の伝播方向と直交する方向の長さが、前記双方向性変換器部分の電極指の弾性表面波の伝播方向と直交する方向の最大長よりも長いことを特徴とするものである。

【００６５】上記理由により、重み付けの方法としてアポタイズ法を用いることによって、位相ずれによるリップルの発生を防止し、リップルのない周波数特性を得ることができる。

【００６６】本発明による請求項２２記載の弾性表面波フィルタ装置は、前記圧電性基板を、水晶基板、タンタル酸リチウム基板又はほう酸リチウム基板としたことを特徴とするものである。

【００６７】上記理由により、圧電性基板として、水晶基板、タンタル酸リチウム基板又はほう酸リチウム基板を用いることによって、温度特性に優れるとともに、低損失の弾性表面波フィルタ装置を実現することができる。

【００６８】

【発明の実施の形態】本発明による弾性表面波フィルタ装置の実施の形態を、図面を参照して詳細に説明する。図１は、本発明による弾性表面波フィルタ装置の第１の実施の形態の線図的平面図である。本実施の形態では、圧電性基板として矩形の水晶基板１を用いる。水晶基板は、温度変化に対する帯域幅変化が微小であるから、温度変化による通過周波数帯域の変化を微小範囲に維持することができる。この水晶基板１の表面上に、入力側変換器２と、シールド電極３と、出力側変換器４とを、弾性表面波の伝播軸線に沿って形成する。

【００６９】入力側変換器２を一方向性変換器とし、この一方向性変換器を、正電極５及び負電極６と、これら正電極５及び負電極６の電極指間に配置した短絡型浮き電極７とで構成する。本実施の形態では、これら正電極５、負電極６及び短絡型浮き電極７の弾性表面波の伝播方向における電極指の幅を、λ_1／１２に設定する。ここで、λ_1を、入力側変換器２で励振される基本弾性表面波の波長とする。

【００７０】正電極５及び負電極６の各電極指をそれぞれλ_1のピッチで形成し、正電極５の電極指と隣接する負電極６の電極指との間の中心間距離をλ_1／２に設定する。また、短絡型浮き電極７の電極指を、これに隣接する正電極５の電極指及び負電極６の電極指との間の中間から、弾性表面波の伝播方向の上流側にλ_1／１２だけ偏位するように配置して、電極の非対称構造に基づく一方向特性を高める。

【００７１】入力側変換器２の正電極５及び負電極６の対数を、例えば４０対に設定する。この対数は、要求されるフィルタ特性に応じて適宜最適条件に設定することができる。

【００７２】本実施の形態では、入力側変換器２において、短絡型浮き電極７の配置位置を、これに隣接する正電極５の電極指と負電極６の電極指との間の中間位置から大幅に偏位させて、非対称構造に基づく一方向伝播を一層増強させることにより、弾性表面波フィルタ装置の挿入損失を小さくしている。

【００７３】出力側変換器４を、正電極８及び負電極９をλ_2／４の中心間距離を以て配置した二つの電極指の組をλ_2のピッチで周期的に複数組形成したスプリット電極構造の双方向変換器で構成し、正電極８の各電極指の組が負電極９の電極指の組とλ_2／２の中心間距離を以てそれぞれ位置するように設定する。ここで、λ_2を、出力側変換器４で励振される基本弾性表面波の波長とする。

【００７４】本実施の形態では、これら正電極８及び負電極９の電極指の幅をλ_2／８に設定する。このように構成することにより、互いに隣接する電極指間の間隔が全てλ_2／８に設定される。出力側変換器４の電極の対数を、例えば３００対に設定する。

【００７５】また、出力側変換器４には、アポタイズ法による重み付けが行われており、正電極８の電極指と負電極９の電極指との交叉幅すなわち開口長を、弾性表面波の伝播方向に沿って変化させてる。

【００７６】入力側変換器２として一方向性変換器を用いるとともに出力側変換器３として双方向性変換器を用いる場合、沪波されるべき信号が端子１０及び１１に入力されると、入力側変換器２によって励起された弾性表面波はほとんど一方向に、すなわち出力側変換器４方向に伝播され、シールド電極３を経て出力側変換器４で電気信号に変換され、端子１２及び１３から沪波された信号が出力される。端子１２及び１３から得られる信号の周波数特性は、一方向性変換器の特性と双方向性変換器の特性とが掛け合わされた特性となる。したがって、トランスバーサル型の弾性表面波フィルタ装置において一方向性変換器と双方向性変換器とを組み合わせることにより、周波数特性については双方向性変換器の良好な特性が活用され、挿入損失及びＴ．Ｔ．Ｅ．レベルについては一方向性変換器の特有な特性が生かされた弾性表面波フィルタ装置を実現することができる。その結果、周波数特性、挿入損失及びＴ．Ｔ．Ｅレベルの要件を全て満たす弾性表面波フィルタ装置を実現することができる。

【００７７】本実施の形態の動作を説明する。本実施の形態では、入力側変換器２で励起される弾性表面波の伝播速度及び出力側変換器４で励起される弾性表面波の伝播速度をそれぞれｖ１及びｖ２とすると、

【数３】

$$\lambda_1 = v1\lambda_2 / v2$$

の関係が成立するように、伝播波長λ_1及びλ_2を設定する。既に説明したように、入力側変換器２で励起され

$$v1 = f1\lambda_1$$

の関係が成立する。同様に、出力側変換器４で励起される弾性表面波の中心周波数をｆ２とすると、

$$v2 = f2\lambda_2$$

の関係が成立する。

【００７８】式（２）から、中心周波数ｆ１は、

$$f1 = v1 / \lambda_1$$

となる。同様に、式（３）から、中心周波数ｆ２は、

$$f2 = v2 / \lambda_2$$

となる。式（１）を式（４）に代入すると、

$$f1 = v2 / \lambda_2$$

となり、これは中心周波数ｆ２と一致する。このようにして、式（１）の関係が成立するように、入力側変換器２で励起される弾性表面波の伝播波長λ_1を、出力側変換器４で励起される弾性表面波の伝播波長λ_2と相違させることにより、入力側変換器２で励起される弾性表面波の中心周波数ｆ１と出力側変換器で励起される弾性表面波の中心周波数ｆ２とを一致させることができるので、従来の利点を維持しつつ、弾性表面波フィルタ装置の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適なものとなる。

【００７９】図２は、本発明による弾性表面波フィルタ装置の第２の実施の形態の線図的平面図である。本実施の形態では、水晶基板２１の表面上に、入力側変換器２２と、シールド電極２３と、出力側変換器２４とを、弾性表面波の伝播軸線に沿って順に形成する。

【００８０】入力側変換器２２を一方向性変換器とし、この一方向性変換器を、λ_1を入力側変換器２２で励起される基本弾性表面波の伝播波長とした場合に、弾性表面波伝播方向における幅がλ_1／８の電極指２５ａをλ_1の中心間距離を以て配置した、第２の電極としての正電極２５と、弾性表面波伝播方向における幅がλ_1／８及び$3\lambda_1$／８の電極指２６ａ及び２６ｂを$3\lambda_1$／８の中心間距離を以て配置した電極指の組をλ_1のピッチで周期的に形成した、第１の電極としての負電極２６とで構成する。また、正電極２５の電極指２５ａと隣接する負電極２６の電極指２６ａとの間の中心間距離を$3\lambda_1$／４に設定する。出力側変換器２４を、正電極２８及び負電極２９を具える図１の出力側変換器４と同一構造とする。

【００８１】電極指２６ａと、弾性表面波伝播方向における幅がその３倍である電極指２６ｂとを組み合わせる構成とすることにより、入力側変換器２６を一方向性変換器として用いた場合、端子３０及び３１に信号が入力されると、励起された弾性表面波は、それぞれの電極指の音響インピーダンスの不整合により反射されるが、そ

（１）

る弾性表面波の中心周波数をｆ１とすると、

【数４】

（２）

【数５】

（３）

【数６】

（４）

【数７】

（５）

【数８】

（６）

の合成ベクトルの位相は電気的な反射波の位相と正反対となるので、合成反射波を零にすることができ、弾性表面波フィルタ装置の挿入損失を技術制することなく反射波をなくすことができる。

【００８２】本実施の形態の動作を説明する。本実施の形態においても、式（１）の関係が成立するように、入力側変換器２２で励起される弾性表面波の伝播波長λ_1を、出力側変換器２４で励起される弾性表面波の伝播波長λ_2と相違させることにより、入力側変換器２２で励起される弾性表面波の中心周波数ｆ１と出力側変換器で励起される弾性表面波の中心周波数ｆ２とを一致させることができるので、従来の利点を維持しつつ、弾性表面波フィルタ装置の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適なものとなる。

【００８３】図３は、本発明による弾性表面波フィルタ装置の第３の実施の形態の線図的平面図である。本実施の形態では、水晶基板４１の中央部に入力側変換器４２を配置し、その両側に第１の出力側変換器４３及び第２の出力側変換器４４をそれぞれ配置する。入力側変換器４２として、正電極４５及び負電極４６を具える図１及び２に示す双方向変換器と同一構造の双方向性変換器を用いる。なお、本実施の形態では、第１の出力側変換器４３及び第２の出力側変換器４４で励起される弾性表面波の伝播波長をλ_3とするとともに、入力側変換器４２で励起される弾性表面波の伝播波長をλ_4とする。

【００８４】また、出力側変換器４３及び４４として、正電極４７及び負電極４８並びに正電極４９及び負電極５０を具える図１に示すような一方向性変換器を用いる。第１の出力側変換器４３の浮き電極は、弾性表面波フィルタ装置の弾性表面波の伝播方向すなわち図に対して左側にλ_3／１２だけ偏位させ、第２の出力側変換器４４の浮き電極は図に対して右側にλ_3／１２だけ偏位させる。

【００８５】入力側変換器４２並びに出力側変換器４３

及び４４の対数をそれぞれ、例えば３００対、４０対及び４０対とする。

【００８６】入力側変換器４２により励起された弾性表面波は、第１の出力側変換器４３及び第２の出力側変換器４４に対して互いに等しいエネルギー量で伝播し、第１の出力側変換器４３及び第２の出力側変換器４４により電気信号に変換される。このような構成により、入力側の双方向性変換器４２により励起された全ての弾性表面波を有効に利用することができ、その結果挿入損失を

$$\lambda_3 = v3\lambda_4 / v4$$

の関係が成立するように、入力側変換器４２で励振される弾性表面波の伝播波長λ_4を、第１の出力側変換器４３及び第２の出力側変換器４４で励振される弾性表面波の伝播波長λ_3と相違させることにより、入力側変換器４２で励振される弾性表面波の中心周波数と第１の出力側変換器４３及び第２の出力側変換器４４で励振される弾性表面波の中心周波数とを一致させることができるので、従来の利点を維持しつつ、弾性表面波フィルタ装置の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適なものとなる。

【００８８】図４は、本発明による弾性表面波フィルタ装置の第４の実施の形態の線図的平面図である。本実施の形態では、水晶基板５１の中央部に入力側変換器５２を配置し、その両側に第１の出力側変換器５３及び第２の出力側変換器５４をそれぞれ配置する。入力側変換器５２として、正電極５５及び負電極５６を具える図１及び２に示す双方向変換器と同一構造の双方向性変換器を用いる。なお、本実施の形態でも、第１の出力側変換器５３及び第２の出力側変換器５４で励振される弾性表面波の伝播波長をλ_3とするとともに、入力側変換器５２で励振される弾性表面波の伝播波長をλ_4とする。

【００８９】また、出力側変換器５３及び５４として、正電極５７及び負電極５８並びに正電極５９及び負電極６０を具える図２に示すような一方向性変換器を用いる。第１の出力側変換器５３の正電極５７を、弾性表面波フィルタ装置の弾性表面波の伝播方向すなわち図に対して左側に、弾性表面波の伝播方向における幅がλ_3／８及び$3\lambda_3$／８の電極指の組を$3\lambda_3$／８の中心間距離を以て配置して構成し、第２の出力側変換器５４の正電極５９を、弾性表面波フィルタ装置の弾性表面波の伝播方向すなわち図に対して右側に、弾性表面波の伝播方向における幅がλ_3／８及び$3\lambda_3$／８の電極指の組を$3\lambda_3$／８の中心間距離を以て配置して構成する。

【００９０】この場合も、上記第３の実施の形態と同様に、入力側変換器５２並びに出力側変換器５３及び５４の対数をそれぞれ、例えば３００対、４０対及び４０対とする。

【００９１】この場合も、上記第３の実施の形態と同様に、入力側の双方向性変換器５２により励起された全て一層低減することができる。

【００８７】本実施の形態の動作を説明する。本実施の形態においても、第１の出力側変換器４３及び第２の出力側変換器４４で励振される弾性表面波の伝播速度をｖ３とし、入力側変換器４２で励振される弾性表面波の伝播速度をｖ４とすると、上記第１及び第２の実施の形態と同様に、

【数９】

（６）

の弾性表面波を有効に利用することができ、その結果挿入損失を一層低減することができる。

【００９２】本実施の形態の動作を説明する。本実施の形態においても、式（６）の関係が成立するように、入力側変換器５２で励起される弾性表面波の伝播波長λ_4を、第１の出力側変換器５３及び第２の出力側変換器５４で励起される弾性表面波の伝播波長λ_3と相違させることにより、入力側変換器５２で励起される弾性表面波の中心周波数と第１の出力側変換器５３及び第２の出力側変換器５４で励起される弾性表面波の中心周波数とを一致させることができるので、従来の利点を維持しつつ、弾性表面波フィルタ装置の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適なものとなる。

【００９３】図５は、本発明による弾性表面波変換器の実施の形態の線図的平面図である。この弾性表面波変換器は、水晶基板６１と、弾性表面波の伝播軸線が互いに一致するように水晶基板６１上に形成されたインタディジタル型の第１及び第２の双方向性変換器部分６２ａ及び６２ｂ並びに一方向性変換器部分６３とを具える。これら第１及び第２双方向性変換器部分６２ａ及び６２ｂは、図１及び２に示す双方向性変換器の電極構造と基本的に同一であり、一方向性変換器部分６３は、図１に示す一方向性変換器の電極構造と基本的に同一である。なお、本実施の形態では、一方向性変換器部分６３で励起される弾性表面波の伝播波長をλ_5とするとともに、第１及び第２双方向性変換器部分６２ａ及び６２ｂで励起される弾性表面波の伝播波長をλ_6とする。

【００９４】第１の双方向性変換器部分６２ａは、中心間距離をλ_6／４にして配置した二つの電極指の組をλ_6のピッチで周期的に複数組形成した正電極６４ａと、同様にλ_6／４の中心間距離を以て配置した二つの電極指の組をλ_6のピッチで周期的に形成し、各電極指の組が正電極の電極指の組とλ_6／２の中心間距離を以てそれぞれ位置する負電極６５ａとを具える。各電極指の弾性表面波の伝播方向における幅をλ_6／８とする。電極指６４ａの電極指とこの電極指に対向する負電極６５ａの電極指との交叉幅を、弾性表面波の伝播方向に沿って重み付けしている。

【００９５】第２の双方向性電極部分６２ｂは、λ_6／４の中心間距離を以て配置した二つの電極指の組をλ_6のピッチで周期的に複数組形成した正電極６４ｂと、同様にλ_6／４の中心間距離を以て配置した二つの電極指の組をλ_6のピッチで周期的に複数組形成し、各電極指の組が正電極６４ｂの電極指の組とλ_6／２の中心間距離を以てそれぞれ位置する負電極６５ｂとを具える。各電極指の弾性表面波の伝播方向における幅をλ_6／８とし、正電極６４ｂの電極指とこの電極指に対向する負電極６５ｂの電極指との交叉幅を、弾性表面波の伝播方向に沿って重み付けしている。

【００９６】一方向性変換器部分６３は、正電極６４ｃ及び負電極６５ｃと、これら正電極６４ｃ及び負電極６５ｃの電極指間に配置した短絡型浮き電極６６とで構成する。この一方向性変換器部分６３を、第１の双方向性

$$\lambda_5 = v5\lambda_6 / v6$$

の関係が成立するように、一方向性変換器部分６３で励起される弾性表面波の伝播波長λ_5を、第１及び第２の双方向性変換器部分６２ａ及び６２ｂで励起される弾性表面波の伝播波長λ_6と相違させることにより、一方向性変換器部分６３で励起される弾性表面波の中心周波数と第１及び第２の双方向性変換器部分６２ａ及び６２ｂで励起される弾性表面波の中心周波数とを一致させることができるので、従来の利点を維持しつつ、弾性表面波フィルタ装置の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適なものとなる。

【００９８】図６は、本発明による弾性表面波フィルタ装置の第５の実施の形態の線図的平面図である。本実施の形態では、弾性表面波フィルタ装置の変換器のうちの一方を図５に示す変換器とする。本実施の形態では、基板７１上に、出力側変換器７２として図１の一方向性変換器を形成し、入力側変換器７３として図５に示す双方向性変換器を用いる。なお、本実施の形態では、入力側変換器７２及び出力側変換器７３の一方向性変換器部分で励起される弾性表面波の伝播波長をλ_7とするとともに、出力側変換器７３の双方向性変換器部分で励起される弾性表面波の伝播波長をλ_8とする。なお、入力側変換器７３は正電極７４及び負電極７５を具え、出力側変換器７２は正電極７６及び負電極７７を具える。

【００９９】図５に示す変換器を、短絡型浮き電極の電極指の偏位方向に応じて入力側変換器及び出力側変換器として用いることができる。すなわち、短絡型浮き電極の電極指を弾性表面波の伝播方向にλ_7／１２偏位させた場合には、出力側変換器として用いられる。それに対して入力側変換器として用いる場合には、弾性表面波の伝播方向と反対の方向にλ_7／１２偏位させる。

【０１００】本実施の形態の動作を説明する。本実施の形態においても、式（７）の関係が成立するように、出力側変換器部分６２ａの電極指及び第２の双方向性変換器部分６２ｂの電極指の最大交叉幅の部分に隣接するように、第１の双方向性変換器部分６２ａと第２の双方向性変換器部分６２ｂとの間に配置する。さらに、一方向性変換器部分６３の開口長を、第１の双方向性変換器部分６２ａ及び第２の双方向性変換器部分６２ｂの最大開口長より大きくする。

【００９７】本実施の形態の動作を説明する。本実施の形態においても、一方向性変換器部分６３で励起される弾性表面波の伝播速度をｖ５とし、第１及び第２の双方向性変換器部分６２ａ及び６２ｂで励起される弾性表面波の伝播速度をｖ６とすると、上記第１～４の実施の形態と同様に、

【数１０】

（７）

力側変換７２及び入力側変換器７３の一方向性変換器部分で励振される弾性表面波の伝播波長λ_7を、入力側変換器７３の双方向性変換器部分で励振される弾性表面波の伝播波長λ_8と相違させることにより、出力側変換７２及び入力側変換器７３の一方向性変換器部分で励振される弾性表面波の中心周波数と出力側変換器７３の双方向性変換器部分で励振される弾性表面波の中心周波数とを一致させることができるので、従来の利点を維持しつつ、弾性表面波フィルタ装置の通過特性の波形を対称にするとともに帯域外スプリアスを有効に低減し、かつ、周波数特性が急峻な弾性表面波フィルタ装置を設計する場合にも好適なものとなる。

【０１０１】本発明は、上記実施の形態に限定されるものではなく、幾多の変更及び変形が可能である。例えば、上記弾性表面波フィルタ装置第１～５の実施の形態及び変換器の実施の形態で、圧電性基板として水晶基板を用いたが、水晶基板の他に、水晶基板とほぼ同等の電機機械結合係数及び反射特性を有するタンタル酸リチウム基板及びほう酸リチウム基板を用いることもできる。

【０１０２】また、第１～４の実施の形態において、入力側変換器として一方向性変換器を用い、出力側変換器として双方向性変換器を用いたが、入力側変換器として双方向性変換器を用い、出力側変換器として一方向性変換器を用いることもできる。

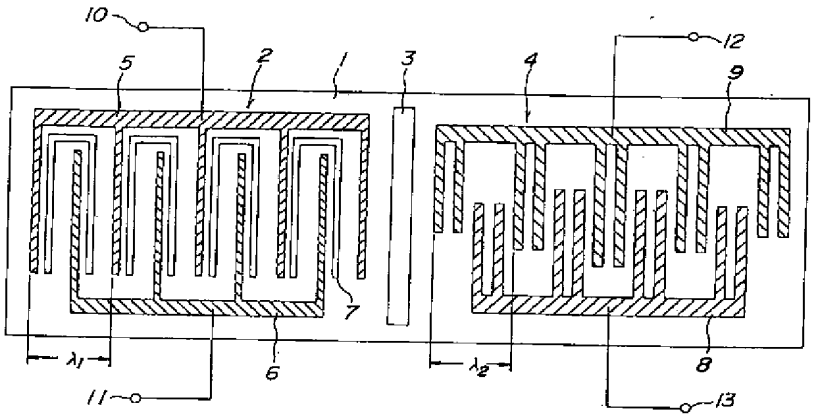
【０１０３】また、上記第２及び第４の実施の形態において、第１の電極として負電極を用い、第２の電極として正電極を用いたが、第１の電極として正電極を用い、第２の電極として負電極を用いることもできる。第１，３及び５の実施の形態において、正電極を負電極として用いるとともに、負電極を正電極として用いることもできる。

【図面の簡単な説明】

【図１】本発明による弾性表面波フィルタ装置の第１の実施の形態の線図的平面図である。

【図２】本発明による弾性表面波フィルタ装置の第２の実施の形態の線図的平面図である。
【図３】本発明による弾性表面波フィルタ装置の第３の実施の形態の線図的平面図である。
【図４】本発明による弾性表面波フィルタ装置の第４の実施の形態の線図的平面図である。
【図５】本発明による弾性表面波変換器の実施の形態の線図的平面図である。
【図６】本発明による弾性表面波フィルタ装置の第５の実施の形態の線図的平面図である。
【符号の説明】
１，２１，４１，５１，６１，７１　水晶基板　２，２２，４２，５２，７３入力側変換器　３，２３　シールド電極　４，２４，４３，４４，５３，５４，７２　出力側変換器　５，８，２５，２８，４５，４７，４９，５５，５７，５９，６４ａ，６４ｂ，６４ｃ，７４，７６　正電極　６，９，２６，２９，４６，４８，５０，５６，５８，６０，６５ａ，６５ｂ，６５ｃ，７５，７７　負電極　７，６６　短絡型浮き電極　１０，１１，１２，１３，３０，３１，３２，３３　端子　２５ａ，２６ａ，２６ｂ　電極指　６２ａ，６２ｂ　双方向性変換器部分　６３　一方向性変換器部分

【図１】



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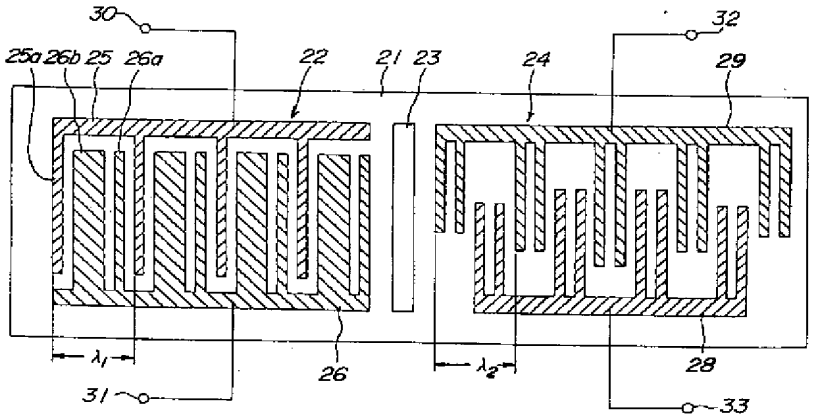

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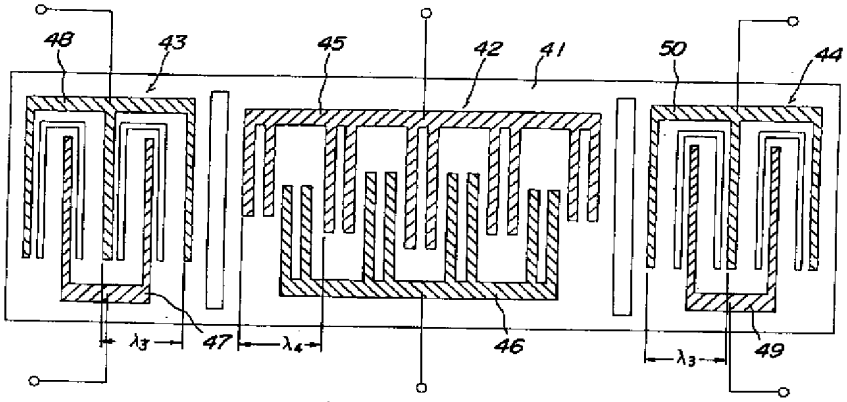
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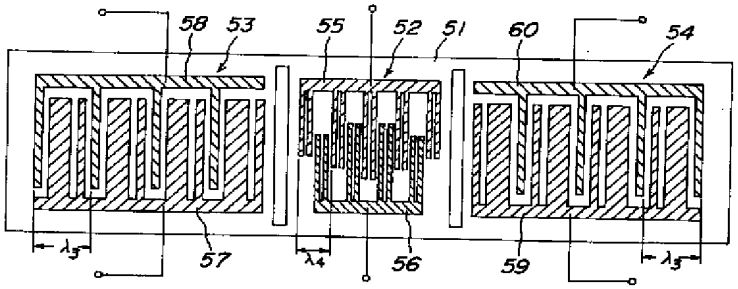
43
45
42
41
50
44
47
46
49
λ3
λ4
λ3

【図４】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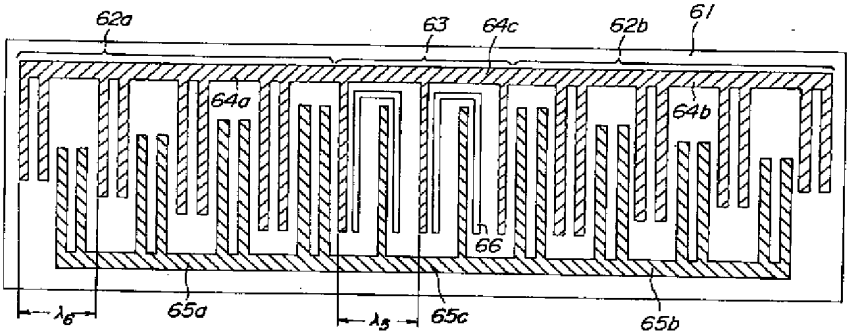
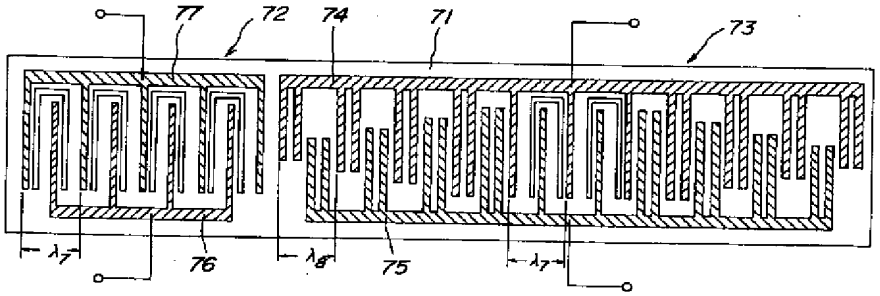
53
55
52
51
60
54
57
56
59
λ5
λ4
λ5

【図５】


62a
63
64c
62b
61
64a
64b
66
65a
65c
65b
λ6
λ5

【図６】



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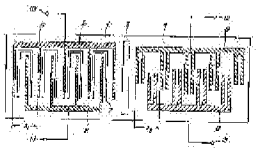
(54) SURFACE ACOUSTIC WAVE FILTER AND TRANSDUCER USED FOR IT



(57)Abstract:
PROBLEM TO BE SOLVED: To make a waveform of a pass characteristic of the surface acoustic wave filter symmetrical, to reduce effectively out-band spurious radiation and to obtain a suitable characteristic in the case of designing the surface acoustic wave filter with a steep frequency characteristic.
SOLUTION: Let a wavelength of a basic surface acoustic wave stimulated by input side transducer 2 be $\lambda 1$ and let a wavelength of a basic surface acoustic wave stimulated by output side transducer 4 be $\lambda 2$, then the surface acoustic wave filter is configured in a relation of $\lambda 1 \neq \lambda 2$ so that a center frequency of the surface acoustic wave stimulated by input side transducer 2 is in matching with a center frequency of the surface acoustic wave stimulated by the output transducer 4.

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CLAIMS

[Claim(s)]

[Claim 1] In surface acoustic wave filter equipment equipped with a piezoelectric substrate, the input-side converter formed on this piezoelectric substrate, and the output side converter which changes the surface acoustic wave excited by this input-side converter On the other hand, either said input-side converter or the output side converters are constituted from a tropism converter. Another side is constituted from a bidirection converter and it is lambda 1. It is lambda 2 while considering as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand. When it considers as the propagation wavelength of the basic surface acoustic

wave excited by said bidirection converter, lambda1 !=lambda2 Surface acoustic wave filter equipment characterized by constituting so that it may become.

[Claim 2] The aforementioned one direction nature converter is lambda 1. When it considers as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand lambda 1 The positive electrode with which it is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has two or more electrode fingers of lambda1 / 12 mostly, It is lambda 1 similarly. It is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda1 / 12 mostly. Each electrode finger the electrode finger of said positive electrode, and the pitch of lambda1 / 2 With, the negative electrode located, respectively, It is arranged between the electrode finger of said positive electrode, and the electrode finger of the negative electrode, and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda1 / 12 mostly. Each electrode finger is equipped with the short circuit mold float electrode which biases in the propagation of a surface acoustic wave, or the direction where this is opposite lambda1 / 12, and is located in it from the mid-position between adjoining electrode fingers of a positive electrode and electrode fingers of the negative electrode. Said bidirection converter is lambda 2. When it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter the pitch of lambda2 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it arranges and is lambda 2 / 8 -- lambda 2 With the positive electrode periodically formed in the pitch With, it is located and the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave is lambda 2 / 8 is periodically formed in the pitch of lambda. the same -- the pitch of lambda2 / 4 -- the group of an electrode finger and the pitch of lambda2 / 2 which said positive electrode adjoins [the group of each electrode finger] -- with, the surface acoustic wave filter equipment according to claim 1 characterized by having the negative electrode located, respectively.

[Claim 3] The aforementioned one direction nature converter is lambda 1. When it considers as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand the width of face in the propagation of a surface acoustic wave -- the electrode finger of lambda1/8, and 3lambda1 / 8 -- the pitch of 3lambda1

/ 8 -- with, the located group of an electrode finger -- lambda 1 With the 1st electrode periodically formed in the pitch the group of said electrode finger with which the width of face in the propagation of a surface acoustic wave adjoins two or more electrode fingers of lambda1 / 8 -- respectively -- the distance of lambda1/2 -- with, it is located -- as -- lambda 1 it formed periodically in the pitch -- It has the 2nd electrode and said bidirection converter is lambda 2. When it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter With, arrange and the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave is lambda 2 / 8 is periodically formed in the pitch of lambda. the pitch of lambda2 / 4 -- the group of an electrode finger and the pitch of lambda/2 which said positive electrode adjoins [the group of each electrode finger] -- with, the surface acoustic wave filter equipment according to claim 1 characterized by having the negative electrode located, respectively.
[Claim 4] Surface acoustic wave filter equipment given in either of the claims 1-3 characterized by considering as said electrode structure which made the tropism converter normal mold electrode structure on the other hand, and carried out weighting of said bidirection converter.
[Claim 5] APOTAIZU in which the lay length to which the propagation of the surface acoustic wave of each electrode finger and the weighting electrode structure of said bidirection converter cross at right angles carries out sequential change along surface acoustic wave propagation -- the surface acoustic wave filter equipment according to claim 4 characterized by being constituted by law.
[Claim 6] Surface acoustic wave filter equipment given in either of the claims 1-5 characterized by using said piezoelectric substrate as the Xtal substrate, a lithium tantalate substrate, or a way acid lithium substrate.
[Claim 7] It has a piezoelectric substrate, the bidirection converter formed on this piezoelectric substrate, and the 1st and 2nd one direction nature converters arranged, respectively on both sides of the axis-of-circulation line of the surface acoustic wave of this bidirection converter. When said bidirection converter is used as an input-side converter, said 1st and 2nd one direction nature converters are used as an output side converter. When said bidirection converter is used as an output side converter, said 1st and 2nd one direction nature converters are used as an input-side converter. lambda 3 It is lambda 4 while considering as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand. It is

lambda3 !=lambda4 when it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter. Surface acoustic wave filter equipment characterized by constituting so that it may become.
[Claim 8] Said 1st and 2nd one direction nature converters are lambda 3. When it considers as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand lambda 3 The positive electrode with which it is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has two or more electrode fingers of lambda3 / 12 mostly, It is similarly formed periodically in the pitch of lambda, and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda3 / 12 mostly. Each electrode finger the electrode finger of said positive electrode, and the pitch of lambda3 / 2 With, the negative electrode located, respectively, It is arranged between the electrode finger of said positive electrode, and the electrode finger of the negative electrode, and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda3 / 12 mostly. Each electrode finger is equipped with the short circuit mold float electrode which biases in the propagation of a surface acoustic wave, or the direction where this is opposite lambda3 / 12, and is located in it from the mid-position between adjoining electrode fingers of a positive electrode and electrode fingers of the negative electrode. Said bidirection converter is lambda 4. When it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter the pitch of lambda4 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it arranges and is lambda 4 / 8 -- lambda 4 With the positive electrode periodically formed in the pitch the same -- the pitch of lambda4 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it is located and is lambda 4 / 8 -- lambda 4 It is periodically formed in a pitch. the group of an electrode finger and the pitch of lambda4 / 2 which said positive electrode adjoins [the group of each electrode finger] -- with, the surface acoustic wave filter equipment according to claim 7 characterized by having the negative electrode located, respectively.
[Claim 9] Said 1st and 2nd one direction nature converters are lambda 3. When it considers as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand the width of face in the propagation of a surface acoustic wave -- the

electrode finger of lambda 1 / 8, and 3lambda3 / 8 -- the pitch of 3lambda3 / 8 -- with, the located group of an electrode finger -- lambda 3 With the 1st electrode periodically formed in the pitch the group of said electrode finger with which the width of face in the propagation of a surface acoustic wave adjoins two or more electrode fingers of lambda3 / 8 -- respectively -- the distance of lambda3 / 2 -- with, it is located -- as -- lambda 3 it formed periodically in the pitch -- It has the 2nd electrode and said bidirection converter is lambda 4. When it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter the pitch of lambda4 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it arranges and is lambda 4 / 8 -- lambda 4 With the positive electrode periodically formed in the pitch the same -- the pitch of lambda4 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it is located and is lambda 4 / 8 -- lambda 4 It is periodically formed in a pitch. the group of an electrode finger and the pitch of lambda4 / 2 which said positive electrode adjoins [the group of each electrode finger] -- with, the surface acoustic wave filter equipment according to claim 7 characterized by having the negative electrode located, respectively.

[Claim 10] Surface acoustic wave filter equipment given in either of the claims 7-9 characterized by considering as said electrode structure which made the tropism converter normal mold electrode structure on the other hand, and carried out weighting of said bidirection converter.

[Claim 11] APOTAIZU in which the lay length to which the propagation of the surface acoustic wave of each electrode finger and the weighting electrode structure of said bidirection converter cross at right angles carries out sequential change along surface acoustic wave propagation -- the surface acoustic wave filter equipment according to claim 10 characterized by being constituted by law.

[Claim 12] Surface acoustic wave filter equipment given in either of the claims 8-11 characterized by using said piezoelectric substrate as the Xtal substrate, a lithium tantalate substrate, or a way acid lithium substrate.

[Claim 13] The bidirection converter part which is a converter for surface acoustic wave filter equipments, and has the bidirection electrode structure which is formed on a piezoelectric substrate and this piezoelectric substrate, and excites a surface acoustic wave in the both directions of the axis-of-circulation line of a surface acoustic wave, While only one direction of the propagation of a surface acoustic

wave excites a surface acoustic wave and it has tropism electrode structure, it has a tropism converter part. It joins together in one so that the axis-of-circulation line of these converter part may be mutually in agreement with these bidirection converter part in a tropism converter part on the other hand. lambda 5 It is lambda 6 while considering as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand. It is lambda5 !=lambda6 when it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter. Converter characterized by constituting so that it may become.
[Claim 14] The aforementioned one direction nature converter part is lambda 5. When it considers as the propagation wavelength of said basic surface acoustic wave excited in a tropism converter part on the other hand lambda 5 The positive electrode with which it is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has two or more electrode fingers of lambda5 / 12 mostly, It is lambda 5 similarly. It is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda5 / 12 mostly. Each electrode finger the electrode finger of said positive electrode, and the pitch of lambda5 / 2 With, the negative electrode located, respectively, It is arranged between the electrode finger of said positive electrode, and the electrode finger of the negative electrode, and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda5 / 12 mostly. Each electrode finger is equipped with the short circuit mold float electrode which biases in the propagation of a surface acoustic wave, or the direction where this is opposite lambda5 / 12, and is located in it from the mid-position between adjoining electrode fingers of a positive electrode and electrode fingers of the negative electrode. Said bidirection converter part is lambda 6. When it considers as the propagation wavelength of the basic surface acoustic wave excited in said bidirection converter part the pitch of lambda6 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it arranges and is lambda 6 / 8 -- lambda 6 With the positive electrode periodically formed in the pitch the same -- the pitch of lambda6 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it is located and is lambda 6 / 8 -- lambda 6 It is periodically formed in a pitch. the group of an electrode finger and the pitch of lambda6 / 2 which said positive electrode adjoins [the group of each electrode finger] -- with, the

converter according to claim 13 characterized by having the negative electrode located, respectively.
[Claim 15] The converter according to claim 13 or 14 characterized by carrying out weighting so that said lay length to which a tropism converter part and the propagation of the surface acoustic wave of each electrode finger and a bidirection converter part cross at right angles may carry out sequential change along the propagation of a surface acoustic wave on the other hand.
[Claim 16] The converter according to claim 15 to which said lay length which intersects perpendicularly with the propagation of the surface acoustic wave of the electrode finger of a tropism converter part on the other hand is characterized by the ******** from the maximum length of the direction which intersects perpendicularly with the propagation of the surface acoustic wave of the electrode finger of said bidirection converter part.
[Claim 17] A converter given in either of the claims 13-16 characterized by using said piezoelectric substrate as the Xtal substrate, a lithium tantalate substrate, or a way acid lithium substrate.
[Claim 18] It has a piezoelectric substrate, the input-side converter formed on this piezoelectric substrate, and the output side converter which changes the surface acoustic wave excited by this input-side converter. The converter of the either said input-side converter or the output side converters is constituted from a tropism converter, while only one direction of the axis-of-circulation line of a surface acoustic wave excites a surface acoustic wave. The bidirection converter part which has the bidirection electrode structure which excites a surface acoustic wave for other converters in the both directions of the axis-of-circulation line of a surface acoustic wave, While only one direction of the propagation of a surface acoustic wave excites a surface acoustic wave and it has tropism electrode structure, it has a tropism converter part. It constitutes from a converter combined in one so that the axis-of-circulation line of these converter part might be mutually in agreement with these bidirection converter part in a tropism converter part on the other hand. lambda 7 It is lambda 8 while considering as the aforementioned one direction nature converter and the propagation wavelength of a basic surface acoustic wave excited in a tropism converter part on the other hand. When it considers as the propagation wavelength of the basic surface acoustic wave excited in said bidirection converter part, lambda7 !=lambda8 Surface acoustic wave filter equipment characterized by constituting so that it may become.
[Claim 19] The aforementioned one direction nature converter and the

aforementioned one direction nature converter part are lambda 7. When [said] it considers as a tropism converter and said propagation wavelength of a basic surface acoustic wave excited in a tropism converter part on the other hand on the other hand lambda 7 The positive electrode with which it is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda7 / 12 mostly, It is lambda 7 similarly. It is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda7 / 12 mostly. Each electrode finger the electrode finger of said positive electrode, and the pitch of lambda7 / 2 With, the negative electrode located, respectively, It is arranged between the electrode finger of said positive electrode, and the electrode finger of the negative electrode, and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda7 / 12 mostly. Each electrode finger is equipped with the short circuit mold float electrode which biases in the propagation of a surface acoustic wave, or the direction where this is opposite lambda7 / 12, and is located in it from the mid-position between adjoining electrode fingers of a positive electrode and electrode fingers of the negative electrode. Said bidirection converter part is lambda 8. When it considers as the propagation wavelength of the basic surface acoustic wave excited in said bidirection converter part the pitch of lambda8 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it arranges and is lambda 8 / 8 -- lambda 8 With the positive electrode periodically formed in the pitch the same -- the pitch of lambda8 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it is located and is lambda 8 / 8 -- lambda 8 It is periodically formed in a pitch. the group of an electrode finger and the pitch of lambda8 / 2 which said positive electrode adjoins [the group of each electrode finger] -- with, the surface acoustic wave filter equipment according to claim 18 characterized by having the negative electrode located, respectively.
[Claim 20] Surface acoustic wave filter equipment according to claim 18 or 19 characterized by carrying out weighting so that said lay length to which a tropism converter part and the propagation of the surface acoustic wave of each electrode finger and a bidirection converter part cross at right angles may carry out sequential change along the propagation of a surface acoustic wave on the other hand.
[Claim 21] Surface acoustic wave filter equipment according to claim 20

with which said lay length which intersects perpendicularly with the propagation of the surface acoustic wave of the electrode finger of a tropism converter part on the other hand is characterized by the ******** rather than the maximum length of the direction which intersects perpendicularly with the propagation of the surface acoustic wave of the electrode finger of said bidirection converter part.
[Claim 22] Surface acoustic wave filter equipment given in either of the claims 18-21 characterized by using said piezoelectric substrate as the Xtal substrate, a lithium tantalate substrate, or a way acid lithium substrate.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to surface acoustic wave filter equipment, especially the suitable surface acoustic wave filter equipment for a CDMA communication mode. Furthermore, this invention relates to the suitable converter for the above-mentioned surface acoustic wave filter equipment.
[0002]
[Description of the Prior Art] Various communication modes are proposed with development of a digital communication system. As such a correspondence procedure, there are an FDMA (Frequency Division Multiple Access) method and a TDMA (time division multiple access) method, for example. By the FDMA method, a frequency band is divided, these are assigned to each radio station, a time zone region is divided by the TDMA method to it, and these are assigned to each radio station.
[0003] Moreover, the CDMA (code division multiple access) method is

proposed in recent years. By this CDMA method, since many numbers of channels are securable by using the signal on which it was superimposed by the frequency and time amount, there is high usefulness, and that development is demanded strongly. The characteristic filter shape is demanded about the surface acoustic wave filter equipment used for this CDMA method, and it is as follows when that property is summarized.
(1) Satisfy the insertion loss of 10 or less dB.
(2) The small frequency characteristics of phase distortion can be acquired.
(3) T.T.E. of 30 or more dB (triple Transit Echo) Satisfy attenuation level.
[0004] In order to satisfy these properties, the surface acoustic wave filter equipment indicated by the publication-number No. 213870 [eight to] official report by this invention person constitutes another side from a bidirection converter while, constituting either an input-side converter or the output side converters from a tropism converter on the other hand. Thus, by [using the bidirection converter which has APOTAIZU electrode structure, and the excitation effectiveness and a reflection effect] on the other hand putting a tropism converter together appropriately The property of a bidirection transducer is utilized about frequency characteristics. About an insertion loss and T.T.E. attenuation level The surface acoustic wave filter equipment with which the property of a tropism transducer is utilized for on the other hand, consequently it is satisfied of all insertion losses, the T.T.E. attenuation level, and frequency characteristics is realizable.
[0005]
[Problem(s) to be Solved by the Invention] With such surface acoustic wave filter equipment, while the wave of the passage property of surface acoustic wave filter equipment becomes unsymmetrical, spurious one out of band cannot be reduced effectively, and this is not desirable for surface acoustic wave filter equipment. Moreover, in designing surface acoustic wave filter equipment with steep frequency characteristics with such surface acoustic wave filter equipment, it is not desirable.
[0006] In the surface acoustic wave filter equipment which, on the other hand, constituted either an input-side converter or the output side converters from a tropism converter, and constituted another side from a bidirection converter, while the 1st purpose of this invention makes the symmetry the wave of the passage property of a surface acoustic wave, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it is offering suitable surface acoustic wave filter

equipment.
[0007] While the 2nd purpose of this invention makes the symmetry the wave of the passage property of a surface acoustic wave at the both sides of the axis-of-circulation line of the surface acoustic wave of a bidirection converter in the 1st and 2nd surface acoustic wave filter equipment which has arranged the tropism converter on the other hand, respectively, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it is offering suitable surface acoustic wave filter equipment.
[0008] The bidirection converter part which has the bidirection electrode structure where the 3rd purpose of this invention excites a surface acoustic wave in the both directions of the axis-of-circulation line of a surface acoustic wave, In the converter to which only one direction of the propagation of a surface acoustic wave excites a surface acoustic wave, which has tropism electrode structure on the other hand and which is equipped with a tropism converter part on the other hand While making the wave of the passage property of a surface acoustic wave into the symmetry, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it is offering a suitable converter.
[0009] The converter to which only one direction of the propagation of the bidirection converter part which has the bidirection electrode structure where the 4th purpose of this invention excites a surface acoustic wave in the both directions of the axis-of-circulation line of a surface acoustic wave, and a surface acoustic wave excites a surface acoustic wave, which has tropism electrode structure on the other hand and which has a tropism converter part on the other hand, In the surface acoustic wave filter equipment equipped with a tropism converter on the other hand, while making the wave of the passage property of a surface acoustic wave into the symmetry, it reduces spurious one out of band effectively. And also when designing surface acoustic wave filter equipment with steep frequency characteristics, it is offering suitable surface acoustic wave filter equipment.
[0010]
[Means for Solving the Problem] The surface acoustic wave filter equipment according to claim 1 by this invention In surface acoustic wave filter equipment equipped with a piezoelectric substrate, the input-side converter formed on this piezoelectric substrate, and the output side converter which changes the surface acoustic wave excited by

this input-side converter On the other hand, either said input-side converter or the output side converters are constituted from a tropism converter. Another side is constituted from a bidirection converter and it is lambda 1. It is lambda 2 while considering as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand. When it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter, lambda1 !=lambda2 It is characterized by constituting so that it may become.

[0011] Since the propagation velocity of the surface acoustic wave excited by the tropism converter on the other hand and the propagation velocity of the surface acoustic wave excited by the bidirection converter were different with the above-mentioned surface acoustic wave filter equipment as a result of this invention person's examining the reason for the ability not to reduce spurious one out of band effectively, while the wave of the passage property of the above-mentioned surface acoustic wave ****** became unsymmetrical, it was checked that it is because the center frequency of these converters shifts.

[0012] Like known before, when the propagation velocity, wavelength, and center frequency of a basic surface acoustic wave are set to V, lambda, and f, it is [Equation 1]. There is relation of V=flambda. Therefore, when both the pitch of the electrode finger of a tropism transducer and the pitch of the electrode finger of a bidirection transducer are set to lambda on the other hand, Namely, when the wavelength of the surface acoustic wave excited by the tropism converter on the other hand and the wavelength of the surface acoustic wave excited by the bidirection converter are the same, If the rate of the surface acoustic wave excited by the tropism converter on the other hand differs from the rate of the surface acoustic wave excited by the bidirection converter, the center frequency of the surface acoustic wave excited by the tropism converter on the other hand will come to shift from the center frequency of the surface acoustic wave excited by the bidirection converter.

[0013] The result to which this invention person examined why the rate of the surface acoustic wave excited by the tropism converter on the other hand in the above-mentioned surface acoustic wave filter equipment differs from the rate of the surface acoustic wave excited by the bidirection converter, In the part in which the electrode finger of the surface areas of a piezoelectric substrate was formed, and the part in which the electrode finger of the surface areas of a piezoelectric substrate is not formed, it checked that it was because the propagation

velocity of a surface acoustic wave is different and these rates come to be different. That is, the rate of the surface acoustic wave which spreads the part in which the electrode finger of the surface areas of a piezoelectric substrate was formed is slower than the rate of the surface acoustic wave which spreads the part in which the electrode finger of the surface areas of a piezoelectric substrate is not formed. Therefore, the rate of the surface acoustic wave which spreads a converter becomes slow as the rate of a part that the electrode finger of the surface areas of the piezoelectric substrate to the whole surface area of the piezoelectric substrate in the propagation of a surface acoustic wave is formed becomes large.

[0014] On the other hand with the above-mentioned surface acoustic wave filter equipment, the rate of a part that the electrode finger of the surface areas of the piezoelectric substrate to the whole surface area of the piezoelectric substrate in the propagation of a surface acoustic wave is formed is different with a tropism converter and bidirection converter side. For example, while floating as a tropism converter on the other hand and using an electrode type-conversion machine, in using an APOTAIZU type-conversion machine as a bidirection converter, while, usually making all the electrode digits of a tropism converter into lambda/12 on the other hand, it makes all width of face of the electrode finger of a bidirection converter into lambda/8. Therefore, on the other hand, total of the electrode digit of the bidirection converter of per 1lambda becomes lambda/2 to total of the electrode digit of a tropism converter becoming [of per 1lambda] lambda/3, and the propagation velocity of the surface acoustic wave excited by the bidirection converter since total of an electrode digit is large becomes slower than the propagation velocity of the surface acoustic wave with which the direction of a bidirection converter side is excited by the tropism converter on the other hand.

[0015] this invention person is the propagation wavelength lambda 1 of the basic surface acoustic wave excited by the tropism converter on the other hand in order to make in agreement with the center frequency of the surface acoustic wave excited by the bidirection converter the center frequency of the surface acoustic wave excited by the tropism converter on the other hand in order to solve the above-mentioned technical problem. It is made to differ from the propagation wavelength lambda 2 of the basic surface acoustic wave excited by the bidirection converter. Furthermore, if propagation velocity of the surface acoustic wave which will spread a tropism converter on the other hand if it explains in detail is set to v1 and propagation velocity of the surface

acoustic wave which spreads a bidirection converter is set to v2 In order to make in agreement with the center frequency of the surface acoustic wave excited by the bidirection converter the center frequency of the surface acoustic wave excited by the tropism converter on the other hand Wavelength lambda 1 of the surface acoustic wave excited by the tropism converter on the other hand as shown in several 1 Wavelength lambda 2 of the surface acoustic wave excited by the bidirection converter In between, it is [Equation 2]. It is lambda 1 so that it may have the relation between lambda1 =v1lambda2 / v2. And lambda 2 It is necessary to set up.

[0016] Thus, it sets to the surface acoustic wave filter equipment which, on the other hand, constituted either an input-side converter or the output side converters from a tropism converter, and constituted another side from a bidirection converter. Since the center frequency of the surface acoustic wave excited by the tropism converter on the other hand and the center frequency of the surface acoustic wave excited by the bidirection converter can be made in agreement Maintaining the conventional advantage, while making the wave of the passage property of surface acoustic wave filter equipment into the symmetry, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it will become suitable.

[0017] The surface acoustic wave filter equipment according to claim 2 by this invention The aforementioned one direction nature converter is lambda 1. When it considers as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand lambda 1 The positive electrode with which it is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has two or more electrode fingers of lambda1 / 12 mostly, It is lambda 1 similarly. It is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda1 / 12 mostly. Each electrode finger the electrode finger of said positive electrode, and the pitch of lambda1 / 2 With, the negative electrode located, respectively, It is arranged between the electrode finger of said positive electrode, and the electrode finger of the negative electrode, and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda1 / 12 mostly. Each electrode finger is equipped with the short circuit mold float electrode which biases in the propagation of a surface acoustic wave, or the direction where this is opposite lambda1 / 12, and is located in it from the mid-position between adjoining electrode fingers of a positive

electrode and electrode fingers of the negative electrode. Said bidirection converter is lambda 2. When it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter the pitch of lambda2 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it arranges and is lambda 2 / 8 -- lambda 2 With the positive electrode periodically formed in the pitch With, it is located and the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave is lambda 2 / 8 is periodically formed in the pitch of lambda. the same -- the pitch of lambda2 / 4 -- the group of an electrode finger and the pitch of lambda2 / 2 which said positive electrode adjoins [the group of each electrode finger] -- with, it is characterized by having the negative electrode located, respectively.

[0018] On the other hand, there is an one direction nature converter [of lambda1 / 8 mold which set the width of face of the propagation of the surface acoustic wave of each electrode plate of a positive electrode the negative electrode, and a float electrode as lambda1 / 8] of lambda1 / 12 mold of a float electrode mold which, on the other hand, set the width of face of the propagation of a tropism converter and the surface acoustic wave of each electrode plate as lambda1 / 12 as a tropism converter. On the other hand, in the case of a tropism converter, the range of lambda1 / 8 type ** which can make the electrode finger of a float electrode bias is too narrow, namely, cannot set the array pitch of each electrode of a positive electrode, the negative electrode, and a float electrode as the width of face (namely, lambda 1 / 8) of an electrode finger, or the integral multiple of this. Consequently, when it combines with a bidirection converter, the reflection effect by the float electrode cannot utilize effectively, therefore an improvement of a property cannot be expected from the field of insertion-loss and G.D.T.

[0019] On the other hand, on the other hand, in the case of a tropism transducer, all the electrode fingers of each electrode can be formed by the array pitch of lambda 1 / 12, or the integral multiple of this, and the reflection effect by the float electrode of lambda1 / 12 mold which set the width of face of each electrode finger of a positive electrode, the negative electrode, and a float electrode as lambda1/12 can be utilized effectively. Consequently, when it combines with a bidirection converter, the surface acoustic wave filter equipment with which may be satisfied of all of insertion losses, G.D.T. frequency characteristics, and T.T.E. can be realized.

[0020] Next, a bidirection converter is examined. As a bidirection

converter, there is a converter which set the width of face of each electrode finger of a positive electrode and the negative electrode as lambda2 / 4. If this converter is caught from the field of excitation effectiveness, it is very useful. However, since the pitch between each edge of an electrode finger is set to lambda2 / 4, the reflected wave produced in each edge of an electrode finger will become an inphase mutually, consequently a big ripple 1dB or more will arise. Therefore, frequency characteristics cannot be satisfied when it combines with a tropism converter on the other hand.

[0021] Moreover, in the case of the bidirection converter which specified the width of face of each electrode finger to lambda2 / 8, since the area of an electrode finger becomes less than lambda2 / 4 mold, excitation effectiveness falls rather than lambda2 / 4 mold. Moreover, since the phase of the reflected wave produced in the edge of an electrode finger shifts mutually, a ripple arises in frequency characteristics. Therefore, when it combines with a tropism converter on the other hand, the property which can be satisfied about an insertion loss and frequency characteristics cannot be acquired.

[0022] On the other hand, width of face makes a pair two electrode fingers of lambda2 / 8, in the case of the bidirection converter of lambda2 / 8 split molds which constituted the electrode finger of a positive electrode and the negative electrode from two electrode ****, the area of an electrode finger is the same as that of lambda2 / 4 mold, and high excitation effectiveness is acquired. Moreover, since the reflected waves generated on the electrode fingertip edge are reflected waves which the phase reversed mutually, very good frequency characteristics without a ripple are acquired.

[0023] Therefore, the surface acoustic wave filter equipment which has the property which un-arranging [of the proper of lambda1 / 12 mold which each converter has about an insertion loss, frequency characteristics, and T.T.E. attenuation level if it combines with a tropism converter on the other hand] was mutually complemented in the bidirection converter which has this lambda2 / 8 split type of electrode structure, consequently was excellent is realizable.

[0024] The surface acoustic wave filter equipment according to claim 3 by this invention The aforementioned one direction nature converter is lambda 1. When it considers as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand the width of face in the propagation of a surface acoustic wave -- the electrode finger of lambda 1 / 8, and 3lambda1 / 8 -- the pitch of 3lambda1 / 8 -- with, the located group of an electrode finger -- lambda

1 With the 1st electrode periodically formed in the pitch the group of said electrode finger with which the width of face in the propagation of a surface acoustic wave adjoins two or more electrode fingers of lambda1 / 8 -- respectively -- the distance of lambda1 / 2 -- with, it is located -- as -- lambda 1 it formed periodically in the pitch -- It has the 2nd electrode and said bidirection converter is lambda 2. When it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter With, arrange and the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave is lambda 2 / 8 is periodically formed in the pitch of lambda. the pitch of lambda2 / 4 -- the group of an electrode finger and the pitch of lambda/2 which said positive electrode adjoins [the group of each electrode finger] -- with, it is characterized by having the negative electrode located, respectively.
[0025] Thus, by considering as the configuration which combines the electrode finger whose width of face in the propagation of a surface acoustic wave is lambda 1 / 8, and the electrode finger whose width of face in the propagation of a surface acoustic wave is 3lambda1 / 8 Although the surface acoustic wave which carried out incidence to the tropism transducer on the other hand is reflected by the mismatching of the acoustic impedance in the edge of each electrode finger Since the phase of the synthetic vector becomes the opposite of the phase of an electric reflected wave, a synthetic reflected wave can be made into zero, and a reflected wave can be lost, without sacrificing an insertion loss.
[0026] The surface acoustic wave filter equipment according to claim 4 by this invention is characterized by considering as said electrode structure which made the tropism converter normal mold electrode structure on the other hand, and carried out weighting of said bidirection converter.
[0027] In this case, on the other hand, a tropism converter has the normal mold electrode structure which is the electrode structure by which the dimension of the direction which intersects perpendicularly with the propagation of the surface acoustic wave of each electrode finger is set up identically, and weighting is not carried out, and a bidirection converter has the electrode structure which carried out weighting to it. In order to set up a damping property out of band greatly, it is necessary to give weighting to a converter. Here, if weighting is made the electrode structure of a tropism converter on the other hand, frequency characteristics will get worse. If a tropism converter is made into weighting electrode structure on the other hand,

since the connection of a short circuit mold float electrode mold which connects the electrode finger of a short circuit mold float electrode comes to be located in an excitation field, a reflected wave [**** / un-] will arise in this part or a propagation velocity difference will arise in the excited surface acoustic wave especially, a strong ripple arises. While making a tropism converter into the electrode structure of a normal mold on the other hand based on such recognition, weighting is performed to a bidirection converter. A property without a ripple can be acquired by making it such a configuration.

[0028] APOTAIZU to which the lay length to which the propagation of the surface acoustic wave of each electrode finger and the weighting electrode structure of said bidirection converter cross at right angles carries out sequential change of the surface acoustic wave filter equipment according to claim 5 by this invention along surface acoustic wave propagation -- it is characterized by being constituted by law.

[0029] the culling-out method which thins out an electrode finger in a desired pitch as the approach of weighting, and Bali Bitsch -- law is known. However, by these approaches, a phase shift arises in the reflected wave in an electrode finger, and this causes a ripple. it -- receiving -- APOTAIZU -- in law, since sequential change of the lay length which intersects perpendicularly with the propagation of the surface acoustic wave of an electrode finger is carried out, generating of the ripple by the phase shift can be prevented and frequency characteristics without a ripple can be acquired.

[0030] The surface acoustic wave filter equipment according to claim 6 by this invention is characterized by using said piezoelectric substrate as the Xtal substrate, a lithium tantalate substrate, or a way acid lithium substrate.

[0031] As a piezoelectric substrate of surface acoustic wave filter equipment, the lithium-niobate substrate, the Xtal substrate, the lithium tantalate substrate, the way acid lithium substrate, etc. are usually used. Among these substrates, since a lithium-niobate substrate has a comparatively big electromechanical coupling coefficient (K2), it has the advantage that the good transfer characteristic is acquired. However, since a difficulty is in the temperature characteristic, there is a fault that change of the bandwidth to a temperature change becomes large, and it has been used only as a filter for broadbands. For this reason, only the filter equipment of a resonance mold has been used as a conventional narrow band filter. However, as for the filter of a resonance mold, fault with large GDT was strongly pointed out from the structure. Since the surface acoustic wave filter equipment which has a

float electrode mold or a dirt type-conversion machine to it uses the unsymmetrical structure of an electrode effectively, it can reduce an insertion loss and GDT sharply. Therefore, even when applying the internal reflection mold electrode structure of unsymmetrical structure to the piezoelectric substrate excellent in the temperature characteristic, and the surface acoustic wave filter equipment with a usually very small change of a band to a temperature change can be realized, therefore it constitutes as a narrow band filter while excelling in GDT and an insertion loss, the surface acoustic wave filter equipment which has a very good filter shape can be realized.

[0032] If such a situation is taken into consideration, according to the surface acoustic wave filter equipment of this invention, the temperature characteristic over a frequency will be very small, and an electromechanical coupling coefficient will be small single or more figures compared with a lithium-niobate substrate, and the piezoelectric substrate with which a reflection coefficient with an electrode finger has a forward reflection coefficient to a short circuit mold float electrode will be used. In this invention, the way acid lithium substrate the Xtal substrate whose electromechanical coupling coefficient is 0.14%, the lithium tantalate substrate whose electromechanical coupling coefficient is 0.64%, or whose electromechanical coupling coefficient is 1.0% as such a piezoelectric substrate is used. Since the frequency drift to a temperature change is minute, these substrates can maintain change of the passage frequency band to the temperature characteristic in the minute range, if either of these substrates is used as a piezoelectric substrate. However, since Xtal, lithium tantalate, and a way acid lithium have the small electromechanical coupling coefficient, if the existing converter is formed as it is, they are unrealizable from a viewpoint of an insertion loss.

[0033] As a result of this invention person's performing examination detailed about the insertion loss in the Xtal substrate, a lithium tantalate substrate, and a way acid lithium substrate, it became clear that the sign of the reflection coefficient of a float electrode had influenced the insertion loss greatly. In the case of the Xtal substrate, a lithium tantalate substrate, and a way acid lithium substrate, compared with an open sand mold float electrode, the direction of a short circuit mold float electrode has a large reflection coefficient. Therefore, it is suitable to use a short circuit mold float electrode as a float electrode. Thus, by constituting, even if it uses the Xtal substrate with a small electromechanical coupling coefficient, while

being able to control an insertion loss in the very small range, consequently excelling in the temperature characteristic, the broadband surface acoustic wave filter equipment of low loss is realizable. Moreover, even when the converter of dirt mold electrode structure is used as a tropism converter on the other hand, while excelling in the temperature characteristic similarly, the broadband surface acoustic wave filter equipment of low loss can be realized.

[0034] Since the frequency drift to a temperature change is minute, the Xtal substrate can maintain change of the passage frequency band by the temperature change in the minute range, if the Xtal substrate is used as a piezoelectric substrate. However, since electric machine association of Xtal is small, if the existing converter is formed as it is, it is unutilizable from a viewpoint of an insertion loss. As a result of this invention person's performing examination detailed about the insertion loss in the Xtal substrate, it became clear that the sign of the reflection coefficient of a float electrode had influenced in an insertion loss strongly. In the case of the Xtal substrate, compared with an open sand mold float electrode, the direction of a short circuit mold float electrode has a large reflection coefficient. Therefore, it is suitable to use a short circuit mold float electrode as a float electrode. Thus, by constituting, even if it uses the Xtal substrate with a small electromechanical coupling coefficient, while being able to control an insertion loss in the very small range, consequently excelling in the temperature characteristic, the broadband surface acoustic wave filter equipment of low loss is realizable. Moreover, even when the converter of dirt mold electrode structure is used as a tropism converter on the other hand, while excelling in the temperature characteristic similarly, the broadband surface acoustic wave filter equipment of low loss can be realized.

[0035] In addition, since it has the almost same electromechanical coupling coefficient and reflection property as the Xtal substrate, a lithium tantalate substrate can be used like the Xtal substrate. Moreover, about a way acid lithium substrate as well as the Xtal substrate, an insertion loss can be improved further and it can use.

[0036] The surface acoustic wave filter equipment according to claim 7 by this invention It has a piezoelectric substrate, the bidirection converter formed on this piezoelectric substrate, and the 1st and 2nd one direction nature converters arranged, respectively on both sides of the axis-of-circulation line of the surface acoustic wave of this bidirection converter. When said bidirection converter is used as an input-side converter, said 1st and 2nd one direction nature converters

are used as an output side converter. When said bidirection converter is used as an output side converter, said 1st and 2nd one direction nature converters are used as an input-side converter. lambda 3 It is lambda 4 while considering as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand. It is lambda3 !=lambda4 when it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter. It is characterized by constituting so that it may become.

[0037] On the other hand, it also sets at the both sides of the axis-of-circulation line of the surface acoustic wave of a bidirection converter to the 1st and 2nd surface acoustic wave filter equipment which has arranged the tropism converter, respectively. Since the center frequency of the 1st and 2nd surface acoustic waves excited by the tropism converter on the other hand and the center frequency of the surface acoustic wave excited by the bidirection converter can be made in agreement for the reason for the above Maintaining the conventional advantage, while making the wave of the passage property of surface acoustic wave filter equipment into the symmetry, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it will become suitable.

[0038] The surface acoustic wave filter equipment according to claim 8 by this invention Said 1st and 2nd one direction nature converters are lambda 3. When it considers as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand lambda 3 The positive electrode with which it is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has two or more electrode fingers of lambda3 / 12 mostly, It is similarly formed periodically in the pitch of lambda, and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda3 / 12 mostly. Each electrode finger the electrode finger of said positive electrode, and the pitch of lambda3 / 2 With, the negative electrode located, respectively, It is arranged between the electrode finger of said positive electrode, and the electrode finger of the negative electrode, and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda3 / 12 mostly. Each electrode finger is equipped with the short circuit mold float electrode which biases in the propagation of a surface acoustic wave, or the direction where this is opposite lambda3 / 12, and is located in it from the mid-position between adjoining electrode fingers of a positive electrode and electrode fingers of the negative electrode. Said

bidirection converter is lambda 4. When it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter the pitch of lambda4 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it arranges and is lambda 4 / 8 -- lambda 4 With the positive electrode periodically formed in the pitch the same -- the pitch of lambda4 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it is located and is lambda 4 / 8 -- lambda 4 It is periodically formed in a pitch. the group of an electrode finger and the pitch of lambda4 / 2 which said positive electrode adjoins [the group of each electrode finger] -- with, it is characterized by having the negative electrode located, respectively.

[0039] Also in this case, the surface acoustic wave filter equipment which has the property which un-arranging [of the proper of lambda3 / 12 mold which each converter has about an insertion loss, frequency characteristics, and T.T.E. attenuation level if it combines with a tropism converter on the other hand] was mutually complemented by the reason for the above in the bidirection converter which has the electrode structure of lambda4 / 8 split molds, consequently was excellent with the reason is realizable.

[0040] The surface acoustic wave filter equipment according to claim 9 by this invention Said 1st and 2nd one direction nature converters are lambda 3. When it considers as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand the width of face in the propagation of a surface acoustic wave -- the electrode finger of lambda 1 / 8, and 3lambda3 / 8 -- the pitch of 3lambda3 / 8 -- with, the located group of an electrode finger -- lambda 3 With the 1st electrode periodically formed in the pitch the group of said electrode finger with which the width of face in the propagation of a surface acoustic wave adjoins two or more electrode fingers of lambda3 / 8 -- respectively -- the distance of lambda3 / 2 -- with, it is located -- as -- lambda 3 it formed periodically in the pitch -- It has the 2nd electrode and said bidirection converter is lambda 4. When it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter the pitch of lambda4 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it arranges and is lambda 4 / 8 -- lambda 4 With the positive electrode periodically formed in the pitch the same -- the pitch of lambda4 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the

propagation of a surface acoustic wave it is located and is lambda 4 / 8 -- lambda 4 It is periodically formed in a pitch. the group of an electrode finger and the pitch of lambda4 / 2 which said positive electrode adjoins [the group of each electrode finger] -- with, it is characterized by having the negative electrode located, respectively.
[0041] Thus, a reflected wave can be lost by considering as the configuration which combines the electrode finger whose width of face in the propagation of a surface acoustic wave is lambda 3 / 8, and the electrode finger whose width of face in the propagation of a surface acoustic wave is 3lambda3 / 8, without sacrificing an insertion loss for the reason for the above.
[0042] The surface acoustic wave filter equipment according to claim 10 by this invention is characterized by considering as said electrode structure which made the tropism converter normal mold electrode structure on the other hand, and carried out weighting of said bidirection converter.
[0043] For the reason for the above, while making a tropism converter into the electrode structure of a normal mold on the other hand, a property without a ripple can be acquired by performing weighting to a bidirection converter.
[0044] APOTAIZU to which the lay length to which the propagation of the surface acoustic wave of each electrode finger and the weighting electrode structure of said bidirection converter cross at right angles carries out sequential change of the surface acoustic wave filter equipment according to claim 11 by this invention along surface acoustic wave propagation -- it is characterized by being constituted by law.
[0045] the reason for the above -- as the approach of weighting -- APOTAIZU -- by using law, generating of the ripple by the phase shift can be prevented and frequency characteristics without a ripple can be acquired.
[0046] The surface acoustic wave filter equipment according to claim 12 by this invention is characterized by using said piezoelectric substrate as the Xtal substrate, a lithium tantalate substrate, or a way acid lithium substrate.
[0047] While excelling in the temperature characteristic as a piezoelectric substrate for the reason for the above by using the Xtal substrate, a lithium tantalate substrate, or a way acid lithium substrate, the surface acoustic wave filter equipment of low loss is realizable.
[0048] The converter according to claim 13 by this invention is a converter for surface acoustic wave filter equipments. A piezoelectric

substrate, The bidirection converter part which has the bidirection electrode structure which is formed on this piezoelectric substrate and excites a surface acoustic wave in the both directions of the axis-of-circulation line of a surface acoustic wave, While only one direction of the propagation of a surface acoustic wave excites a surface acoustic wave and it has tropism electrode structure, it has a tropism converter part. It joins together in one so that the axis-of-circulation line of these converter part may be mutually in agreement with these bidirection converter part in a tropism converter part on the other hand. lambda 5 It is lambda 6 while considering as the propagation wavelength of said basic surface acoustic wave excited by the tropism converter on the other hand. It is lambda5 !=lambda6 when it considers as the propagation wavelength of the basic surface acoustic wave excited by said bidirection converter. It is characterized by constituting so that it may become.

[0049] The bidirection converter part which has the bidirection electrode structure which excites a surface acoustic wave in the both directions of the axis-of-circulation line of a surface acoustic wave, Also in the converter to which only one direction of the propagation of a surface acoustic wave excites a surface acoustic wave, which has tropism electrode structure on the other hand and which is equipped with a tropism converter part on the other hand Since the center frequency of the surface acoustic wave excited in a tropism converter part on the other hand and the center frequency of the surface acoustic wave excited in a bidirection converter part can be made in agreement for the reason for the above Maintaining the conventional advantage, also when combining with other converters and using, while making the wave of the passage property of surface acoustic wave filter equipment into the symmetry, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it will become suitable.

[0050] The converter according to claim 14 by this invention the aforementioned one direction nature converter part lambda 5 It is lambda 5 when it considers as the propagation wavelength of said basic surface acoustic wave excited by the tropism transducer on the other hand. The positive electrode with which it is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has two or more electrode fingers of lambda5/12 mostly, It is lambda 5 similarly. It is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda5 / 12 mostly. Each electrode finger the electrode finger of said

positive electrode, and the pitch of lambda5 / 2 With, the negative electrode located, respectively, It is arranged between the electrode finger of said positive electrode, and the electrode finger of the negative electrode, and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda5 / 12 mostly. Each electrode finger is equipped with the short circuit mold float electrode which biases in the propagation of a surface acoustic wave, or the direction where this is opposite lambda5 / 12, and is located in it from the mid-position between adjoining electrode fingers of a positive electrode and electrode fingers of the negative electrode. Said bidirection converter part is lambda 6. When it considers as the propagation wavelength of the basic surface acoustic wave excited in said bidirection converter part the pitch of lambda6 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it arranges and is lambda 6 / 8 -- lambda 6 With the positive electrode periodically formed in the pitch the same -- the pitch of lambda6 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it is located and is lambda 6 / 8 -- lambda 6 It is periodically formed in a pitch. the group of an electrode finger and the pitch of lambda6 / 2 which said positive electrode adjoins [the group of each electrode finger] -- with, it is characterized by having the negative electrode located, respectively.

[0051] Also in this case, the converter which has the property which un-arranging [of the proper of lambda5 / 12 mold which each converter part has about an insertion loss, frequency characteristics, and T.T.E. attenuation level if it combines with a tropism converter part on the other hand] was mutually complemented by the reason for the above in the bidirection converter part which has the electrode structure of lambda6 / 8 split molds, consequently was excellent with the reason is realizable.

[0052] The converter according to claim 15 by this invention is characterized by carrying out weighting so that said lay length to which a tropism converter part and the propagation of the surface acoustic wave of each electrode finger and a bidirection converter part cross at right angles may carry out sequential change along the propagation of a surface acoustic wave on the other hand.

[0053] For the reason for the above, a property without a ripple can be acquired by on the other hand performing weighting into a tropism converter part and a bidirection converter part.

[0054] The converter according to claim 16 by this invention is

characterized by the ******** from the maximum length of the direction where the propagation of the surface acoustic wave of the electrode finger of said bidirection converter part and said lay length which intersects perpendicularly with the propagation of the surface acoustic wave of the electrode finger of a tropism converter part on the other hand cross at right angles.

[0055] the reason for the above -- as the approach of weighting -- APOTAIZU -- by using law, generating of the ripple by the phase shift can be prevented and frequency characteristics without a ripple can be acquired.

[0056] The transducer according to claim 17 by this invention is characterized by using said piezoelectric substrate as the Xtal substrate, a lithium tantalate substrate, or a way acid lithium substrate.

[0057] When using as a piezoelectric substrate for the reason for the above combining other converters by using the Xtal substrate, a lithium tantalate substrate, or a way acid lithium substrate, while excelling in the temperature characteristic, the surface acoustic wave filter equipment of low loss is realizable.

[0058] The surface acoustic wave filter equipment according to claim 18 by this invention It has a piezoelectric substrate, the input-side converter formed on this piezoelectric substrate, and the output side converter which changes the surface acoustic wave excited by this input-side converter. The converter of the either said input-side converter or the output side converters is constituted from a tropism converter, while only one direction of the axis-of-circulation line of a surface acoustic wave excites a surface acoustic wave. The bidirection converter part which has the bidirection electrode structure which excites a surface acoustic wave for other converters in the both directions of the axis-of-circulation line of a surface acoustic wave, While only one direction of the propagation of a surface acoustic wave excites a surface acoustic wave and it has tropism electrode structure, it has a tropism converter part. It constitutes from a converter combined in one so that the axis-of-circulation line of these converter part might be mutually in agreement with these bidirection converter part in a tropism converter part on the other hand. lambda 7 It is lambda 8 while considering as the aforementioned one direction nature converter and the propagation wavelength of a basic surface acoustic wave excited in a tropism converter part on the other hand. It is lambda7 !=lambda8 when it considers as the propagation wavelength of the basic surface acoustic wave excited in said bidirection converter part. It is characterized by

constituting so that it may become.
[0059] The converter to which only one direction of the propagation of the bidirection converter part which has the bidirection electrode structure which excites a surface acoustic wave in the both directions of the axis-of-circulation line of a surface acoustic wave, and a surface acoustic wave excites a surface acoustic wave, which has tropism electrode structure on the other hand and which has a tropism converter part on the other hand, In the surface acoustic wave filter equipment equipped with a tropism converter on the other hand for the reason for the above On the other hand, since a tropism converter part side and the frequency of a surface acoustic wave excited by the tropism converter side on the other hand, and the center frequency of the surface acoustic wave excited by the bidirection converter side can be made in agreement Maintaining the conventional advantage, while making the wave of the passage property of surface acoustic wave filter equipment into the symmetry, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it will become suitable.
[0060] The surface acoustic wave filter equipment according to claim 19 by this invention The aforementioned one direction nature converter and the aforementioned one direction nature converter part are lambda 7. When [said] it considers as a tropism converter and said propagation wavelength of a basic surface acoustic wave excited in a tropism converter part on the other hand on the other hand lambda 7 The positive electrode with which it is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda7 / 12 mostly, It is lambda 7 similarly. It is periodically formed in a pitch and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda7 / 12 mostly. Each electrode finger the electrode finger of said positive electrode, and the pitch of lambda7 / 2 With, the negative electrode located, respectively, It is arranged between the electrode finger of said positive electrode, and the electrode finger of the negative electrode, and the width of face of the propagation of a surface acoustic wave has the electrode finger of lambda7 / 12 mostly. Each electrode finger is equipped with the short circuit mold float electrode which biases in the propagation of a surface acoustic wave, or the direction where this is opposite lambda7 / 12, and is located in it from the mid-position between adjoining electrode fingers of a positive electrode and electrode fingers of the negative electrode. Said bidirection converter part is lambda 8. When it considers as the

propagation wavelength of the basic surface acoustic wave excited in said bidirection converter part the pitch of lambda8 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it arranges and is lambda 8 / 8 -- lambda 8 With the positive electrode periodically formed in the pitch the same -- the pitch of lambda8 / 4 -- with, the group of the electrode finger which is two pieces whose width of face of the propagation of a surface acoustic wave it is located and is lambda 8 / 8 -- lambda 8 It is periodically formed in a pitch. the group of an electrode finger and the pitch of lambda8 / 2 which said positive electrode adjoins [the group of each electrode finger] -- with, it is characterized by having the negative electrode located, respectively.
[0061] Also in this case, the surface acoustic wave filter equipment which has the property which un-arranging [of the proper of lambda7 / 12 mold which each converter has about an insertion loss, frequency characteristics, and T.T.E. attenuation level if it combines with a tropism converter on the other hand] was mutually complemented by the reason for the above in the bidirection converter which has the electrode structure of lambda8 / 8 split molds, consequently was excellent with the reason is realizable.
[0062] The surface acoustic wave filter equipment according to claim 20 by this invention is characterized by carrying out weighting so that said lay length to which a tropism converter part and the propagation of the surface acoustic wave of each electrode finger and a bidirection converter part cross at right angles may carry out sequential change along the propagation of a surface acoustic wave on the other hand.
[0063] For the reason for the above, a property without a ripple can be acquired by on the other hand performing weighting into a tropism converter part and a bidirection converter part.
[0064] The surface acoustic wave filter equipment according to claim 21 by this invention is characterized by the ******** rather than the maximum length of the direction where the propagation of the surface acoustic wave of the electrode finger of said bidirection converter part and said lay length which intersects perpendicularly with the propagation of the surface acoustic wave of the electrode finger of a tropism converter part on the other hand cross at right angles.
[0065] the reason for the above -- as the approach of weighting -- APOTAIZU -- by using law, generating of the ripple by the phase shift can be prevented and frequency characteristics without a ripple can be acquired.
[0066] The surface acoustic wave filter equipment according to claim 22

by this invention is characterized by using said piezoelectric substrate as the Xtal substrate, a lithium tantalate substrate, or a way acid lithium substrate.
[0067] While excelling in the temperature characteristic as a piezoelectric substrate for the reason for the above by using the Xtal substrate, a lithium tantalate substrate, or a way acid lithium substrate, the surface acoustic wave filter equipment of low loss is realizable.
[0068]
[Embodiment of the Invention] The gestalt of operation of the surface acoustic wave filter equipment by this invention is explained to a detail with reference to a drawing. Drawing 1 is the diagram-top view of the gestalt of operation of the 1st of the surface acoustic wave filter equipment by this invention. With the gestalt of this operation, the rectangular Xtal substrate 1 is used as a piezoelectric substrate. Since the bandwidth change to a temperature change is minute, the Xtal substrate can maintain change of the passage frequency band by the temperature change in the minute range. On the front face of this Xtal substrate 1, the input-side converter 2, a screening electrode 3, and the output side converter 4 are formed along with the axis-of-circulation line of a surface acoustic wave.
[0069] On the other hand, the input-side converter 2 is used as a tropism converter, and it constitutes from this short circuit mold float electrode 7 that has arranged the tropism converter on the other hand between the electrode fingers of a positive electrode 5 and the negative electrode 6, and the these positive electrodes 5 and the negative electrode 6. With the gestalt of this operation, the width of face of the electrode finger in the propagation of the surface acoustic wave of these positive electrodes 5, the negative electrode 6, and the short circuit mold float electrode 7 is set as lambda1 / 12. Here, it is lambda 1. It considers as the wavelength of the basic surface acoustic wave excited by the input-side converter 2.
[0070] It is each electrode finger of a positive electrode 5 and the negative electrode 6, respectively lambda 1 It forms in a pitch and the pitch between the electrode fingers of the negative electrode 6 which adjoins the electrode finger of a positive electrode 5 is set as lambda1 / 2. Moreover, the electrode finger of the short circuit mold float electrode 7 is arranged as biased only in lambda1 / 12 to the upstream of the propagation of a surface acoustic wave from the middle between the electrode finger of the positive electrode 5 which adjoins this, and the electrode finger of the negative electrode 6, and the one direction

property based on the unsymmetrical structure of an electrode is raised.
[0071] The logarithm of the positive electrode 5 of the input-side converter 2 and the negative electrode 6 is set as 40 pairs. This logarithm can be suitably set as optimum conditions according to the filter shape demanded.
[0072] With the gestalt of this operation, the insertion loss of surface acoustic wave filter equipment is made small in the input-side converter 2 by making the arrangement location of the short circuit mold float electrode 7 bias sharply from the mid-position between the electrode fingers of a positive electrode 5 and the electrode fingers of the negative electrode 6 which adjoin this, and reinforcing further the one direction propagation based on unsymmetrical structure.
[0073] the output side converter 4 -- a positive electrode 8 and the negative electrode 9 -- the pitch of lambda2 / 4 -- with, the group of two arranged electrode fingers -- lambda 2 the congruence directional change machine of the split electrode structure periodically formed two or more sets in the pitch -- constituting -- the group of each electrode finger of a positive electrode 8 -- the group of the electrode finger of the negative electrode 9, and the pitch of lambda2 / 2 -- with, it sets up so that it may be located, respectively. Here, it is lambda 2. It considers as the wavelength of the basic surface acoustic wave excited by the output side converter 4.
[0074] With the gestalt of this operation, the width of face of the electrode finger of these positive electrodes 8 and the negative electrode 9 is set as lambda2 / 8. Thus, by constituting, all spacing between the electrode fingers which adjoin mutually is set as lambda2 / 8. The logarithm of the electrode of the output side converter 4 is set as 300 pairs.
[0075] moreover -- the output side converter 4 -- APOTAIZU -- weighting by law is performed and it is changing along the propagation of a surface acoustic wave, the decussation width of face, i.e., the opening length, of the electrode finger of a positive electrode 8, and the electrode finger of the negative electrode 9.
[0076] If the signal which should be filtered is inputted into terminals 10 and 11 when using a bidirection converter as an output side converter 3, while using a tropism converter on the other hand as an input-side converter 2, most surface acoustic waves excited by the input-side converter 2 will be spread in an one direction, i.e., the output side converter 4 direction, it will be changed into an electrical signal by the output side converter 4 through a screening electrode 3, and the signal filtered from terminals 12 and 13 will be outputted. The

frequency characteristics of the signal acquired from terminals 12 and 13 turn into the property that on the other hand the property of a tropism converter and the property of a bidirection converter were multiplied. Therefore, by on the other hand combining a tropism converter and a bidirection converter in the surface acoustic wave filter equipment of a transversal mold, a property with a bidirection converter good about frequency characteristics is utilized, and the surface acoustic wave filter equipment with which the property with a characteristic tropism converter was employed efficiently on the other hand can be realized about an insertion loss and T.T.E. level. Consequently, the surface acoustic wave filter equipment which satisfies all the requirements for frequency characteristics, an insertion loss, and T.T.E level is realizable.

[0077] Actuation of the gestalt of this operation is explained. It is [Equation 3] when propagation velocity of the surface acoustic wave excited with the gestalt of this operation by the propagation velocity and the output side converter 4 of a surface acoustic wave which are excited by the input-side converter 2 is set to v1 and v2, respectively.

lambda1 =v1lambda2 / v2 (1)

It is the propagation wavelength lambda 1 so that ****** may be materialized. And lambda 2 It sets up. It is [Equation 4] when center frequency of the surface acoustic wave excited by the input-side converter 2 is set to f1, as already explained.

v1=f1lambda1 (2)

****** is materialized. It is [Equation 5] when similarly center frequency of the surface acoustic wave excited by the output side converter 4 is set to f2.

v2=f2lambda2 (3)

****** is materialized.

[0078] A formula (2) to the center frequency f1 is [Equation 6].

f1=v1/lambda1 (4)

It becomes. Similarly, a formula (3) to the center frequency f2 is [Equation 7].

f2=v2/lambda2 (5)

It becomes. It is [Equation 8] when a formula (1) is substituted for a formula (4).

f1=v2/lambda2 (6)

A next door and this are in agreement with center frequency f2. Thus, propagation wavelength lambda 1 of the surface acoustic wave excited by the input-side converter 2 so that the relation of a formula (1) may be materialized Propagation wavelength lambda 2 of the surface acoustic

wave excited by the output side converter 4 By making it different Since the center frequency f1 of the surface acoustic wave excited by the input-side converter 2 and the center frequency f2 of the surface acoustic wave excited by the output side converter can be made in agreement Maintaining the conventional advantage, while making the wave of the passage property of surface acoustic wave filter equipment into the symmetry, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it will become suitable.

[0079] Drawing 2 is the diagram-top view of the gestalt of operation of the 2nd of the surface acoustic wave filter equipment by this invention. With the gestalt of this operation, the input-side converter 22, a screening electrode 23, and the output side converter 24 are formed in order along with the axis-of-circulation line of a surface acoustic wave on the front face of the Xtal substrate 21.

[0080] On the other hand, the input-side converter 22 is used as a tropism converter, and it is this one direction nature converter lambda 1 When it considers as the propagation wavelength of the basic surface acoustic wave excited by the input-side converter 22 The width of face in surface acoustic wave propagation is electrode finger 25a of lambda1 / 8 lambda 1 A pitch With, the arranged positive electrode 25 as the 2nd electrode, the width of face in surface acoustic wave propagation -- the electrode fingers 26a and 26b of lambda 1 / 8, and 3lambda1 / 8 -- the pitch of 3lambda1 / 8 -- with, the group of the arranged electrode finger -- lambda 1 It constitutes from the negative electrode 26 as the 1st electrode periodically formed in the pitch. Moreover, the pitch between electrode finger 26a of the negative electrode 26 which adjoins electrode finger 25a of a positive electrode 25 is set as 3lambda1 / 4. The output side converter 24 is made into the same structure as the output side converter 4 of drawing 1 equipped with a positive electrode 28 and the negative electrode 29.

[0081] Electrode finger 26a and the width of face in surface acoustic wave propagation by considering as the configuration with which the electrode finger 26b they are [b] 3 times is combined Although the excited surface acoustic wave will be reflected by the mismatching of the acoustic impedance of each electrode finger if a signal is inputted into terminals 30 and 31 when the input-side converter 26 is used as a tropism converter on the other hand Since the phase of the synthetic vector becomes the opposite of the phase of an electric reflected wave, a synthetic reflected wave can be made into zero, and a reflected wave can be lost, without carrying out the technical system of the insertion

loss of surface acoustic wave filter equipment.
[0082] Actuation of the gestalt of this operation is explained. Propagation wavelength lambda 1 of the surface acoustic wave excited by the input-side converter 22 also in the gestalt of this operation so that the relation of a formula (1) may be materialized Propagation wavelength lambda 2 of the surface acoustic wave excited by the output side converter 24 By making it different Since the center frequency f1 of the surface acoustic wave excited by the input-side converter 22 and the center frequency f2 of the surface acoustic wave excited by the output side converter can be made in agreement Maintaining the conventional advantage, while making the wave of the passage property of surface acoustic wave filter equipment into the symmetry, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it will become suitable.
[0083] Drawing 3 is the diagram-top view of the gestalt of operation of the 3rd of the surface acoustic wave filter equipment by this invention. With the gestalt of this operation, the input-side converter 42 is arranged in the center section of the Xtal substrate 41, and the 1st output side converter 43 and the 2nd output side converter 44 are arranged on the both sides, respectively. The bidirection converter of the same structure as the congruence directional change machine shown in drawing 1 equipped with a positive electrode 45 and the negative electrode 46 and 2 as an input-side converter 42 is used. In addition, it is the propagation wavelength of the surface acoustic wave excited with the gestalt of this operation by the 1st output side converter 43 and the 2nd output side converter 44 lambda 3 It is the propagation wavelength of the surface acoustic wave excited by the input-side converter 42 while carrying out lambda 4 It carries out.
[0084] Moreover, a tropism converter is used while it seems that it is shown in drawing 1 which equips a positive electrode 47 and negative electrode 48 list with a positive electrode 49 and the negative electrode 50 as output side converters 43 and 44. Only lambda3 / 12 make left-hand side bias the float electrode of the 1st output side converter 43 to the propagation, i.e., drawing, of a surface acoustic wave of surface acoustic wave filter equipment, and only lambda3 / 12 make right-hand side bias the float electrode of the 2nd output side converter 44 to drawing.
[0085] The logarithm of the output side converters 43 and 44 is made into 300 pairs, 40 pairs, and 40 pairs at input-side converter 42 list, respectively.

[0086] The surface acoustic wave excited by the input-side converter 42 is mutually spread in the equal amount of energy to the 1st output side converter 43 and the 2nd output side converter 44, and is changed into an electrical signal by the 1st output side converter 43 and the 2nd output side converter 44. By such configuration, all the surface acoustic waves excited by the bidirection converter 42 of an input side can be used effectively, and, as a result, an insertion loss can be reduced further.
[0087] Actuation of the gestalt of this operation is explained. When propagation velocity of the surface acoustic wave excited by the 1st output side converter 43 and the 2nd output side converter 44 is set to v3 also in the gestalt of this operation and propagation velocity of the surface acoustic wave excited by the input-side converter 42 is set to v4, it is [Equation 9] like the gestalt of the above 1st and the 2nd implementation.
lambda3 =v3lambda4 / v4 (6)
Propagation wavelength lambda 4 of the surface acoustic wave excited by the input-side converter 42 so that ****** may be materialized
Propagation wavelength lambda 3 of the surface acoustic wave excited by the 1st output side converter 43 and the 2nd output side converter 44 By making it different Since the center frequency of the surface acoustic wave excited by the center frequency of a surface acoustic wave, the 1st output side converter 43, and the 2nd output side converter 44 which are excited by the input-side converter 42 can be made in agreement
Maintaining the conventional advantage, while making the wave of the passage property of surface acoustic wave filter equipment into the symmetry, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it will become suitable.
[0088] Drawing 4 is the diagram-top view of the gestalt of operation of the 4th of the surface acoustic wave filter equipment by this invention. With the gestalt of this operation, the input-side converter 52 is arranged in the center section of the Xtal substrate 51, and the 1st output side converter 53 and the 2nd output side converter 54 are arranged on the both sides, respectively. The bidirection converter of the same structure as the congruence directional change machine shown in drawing 1 equipped with a positive electrode 55 and the negative electrode 56 and 2 as an input-side converter 52 is used. In addition, it is the propagation wavelength of the surface acoustic wave excited also with the gestalt of this operation by the 1st output side converter 53 and the 2nd output side converter 54 lambda 3 It is the propagation

wavelength of the surface acoustic wave excited by the input-side converter 52 while carrying out lambda 4 It carries out.
[0089] Moreover, a tropism converter is used while it seems that it is shown in drawing 2 which equips a positive electrode 57 and negative electrode 58 list with a positive electrode 59 and the negative electrode 60 as output side converters 53 and 54. The positive electrode 57 of the 1st output side converter 53 is received, the propagation, i.e., drawing, of a surface acoustic wave of surface acoustic wave filter equipment. On left-hand side With, it arranges and constitutes. the width of face in the propagation of a surface acoustic wave -- the group of the electrode finger of lambda 3 / 8, and 3lambda3 / 8 -- the pitch of 3lambda3 / 8 -- width of face [in / to the propagation, i.e., drawing, of a surface acoustic wave of surface acoustic wave filter equipment / for the positive electrode 59 of the 2nd output side converter 54 / to right-hand side / the propagation of a surface acoustic wave] -- the group of the electrode finger of lambda 3 / 8, and 3lambda3 / 8 -- the pitch of 3lambda3 / 8 -- with, it arranges and constitutes.
[0090] Also in this case, the logarithm of the output side converters 53 and 54 is made into 300 pairs, 40 pairs, and 40 pairs like the gestalt of implementation of the above 3rd at input-side converter 52 list, respectively.
[0091] Also in this case, like the gestalt of implementation of the above 3rd, all the surface acoustic waves excited by the bidirection converter 52 of an input side can be used effectively, and, as a result, an insertion loss can be reduced further.
[0092] Actuation of the gestalt of this operation is explained. propagation wavelength lambda 4 of the surface acoustic wave excited by the input-side converter 52 also in the gestalt of this operation so that the relation of a formula (6) may be materialized Propagation wavelength lambda 3 of the surface acoustic wave excited by the 1st output side converter 53 and the 2nd output side converter 54 By making it different Since the center frequency of the surface acoustic wave excited by the center frequency of a surface acoustic wave, the 1st output side converter 53, and the 2nd output side converter 54 which are excited by the input-side converter 52 can be made in agreement Maintaining the conventional advantage, while making the wave of the passage property of surface acoustic wave filter equipment into the symmetry, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it will become suitable.

[0093] Drawing 5 is the diagram-top view of the gestalt of operation of the surface acoustic wave converter by this invention. On the other hand, this surface acoustic wave converter equips with the tropism converter part 63 1st [of an INTADIJITARU mold], and 2nd bidirection converter partial 62a and 62b list which were formed on the Xtal substrate 61 so that the Xtal substrate 61 and the axis-of-circulation line of a surface acoustic wave might be mutually in agreement. These 1st and 2nd bidirection converter parts 62a and 62b are fundamentally [as the electrode structure of the bidirection converter shown in drawing 1 and 2] the same, and on the other hand, while the tropism converter part 63 is shown in drawing 1 , it is fundamentally [as the electrode structure of a tropism converter] the same. In addition, it is the propagation wavelength of the surface acoustic wave excited in the tropism converter part 63 on the other hand in the gestalt of this operation lambda 5 It is the propagation wavelength of the surface acoustic wave excited in the 1st and 2nd bidirection converter parts 62a and 62b while carrying out lambda 6 It carries out.

[0094] 1st bidirection converter partial 62a is the group of two electrode fingers which set the pitch to lambda6 / 4 and have arranged it lambda 6 Positive electrode 64a periodically formed two or more sets in the pitch, the same -- the pitch of lambda6 / 4 -- with, the group of two arranged electrode fingers -- lambda 6 a pitch -- periodic -- forming -- the group of each electrode finger -- the group of the electrode finger of a positive electrode, and the pitch of lambda6 / 2 -- with, it has negative electrode 65a located, respectively. Width of face in the propagation of the surface acoustic wave of each electrode finger is set to lambda6 / 8. Weighting of the decussation width of face of the electrode finger of electrode finger 64a and the electrode finger of negative electrode 65a which counters this electrode finger is carried out along the propagation of a surface acoustic wave.

[0095] 2nd bidirection electrode section 62b -- the pitch of lambda6 / 4 -- with, the group of two arranged electrode fingers -- lambda 6 With positive electrode 64b periodically formed two or more sets in the pitch the same -- the pitch of lambda6 / 4 -- with, the group of two arranged electrode fingers -- lambda 6 a pitch -- periodic -- two or more sets -- forming -- the group of each electrode finger -- the group of the electrode finger of positive electrode 64b, and the pitch of lambda6 / 2 -- with, it has negative electrode 65b located, respectively. Width of face in the propagation of the surface acoustic wave of each electrode finger is set to lambda6 / 8, and weighting of the decussation width of face of the electrode finger of positive electrode 64b and the electrode

finger of negative electrode 65b which counters this electrode finger is carried out along the propagation of a surface acoustic wave.
[0096] On the other hand, the tropism converter part 63 consists of short circuit mold float electrodes 66 arranged between the electrode fingers of positive electrode 64c and negative electrode 65c, and these positive electrode 64c and negative electrode 65c. This one direction nature converter part 63 is arranged between 1st bidirection converter partial 62a and 2nd bidirection converter partial 62b so that the part of the maximum decussation width of face of the electrode finger of 1st bidirection converter partial 62a and the electrode finger of 2nd bidirection converter partial 62b may be adjoined. Furthermore, on the other hand, the opening length of the tropism converter part 63 is made larger than the maximum-mandibular-movements length of 1st bidirection converter partial 62a and 2nd bidirection converter partial 62b.
[0097] Actuation of the gestalt of this operation is explained. When propagation velocity of the surface acoustic wave excited in the tropism converter part 63 on the other hand is set to v5 also in the gestalt of this operation and propagation velocity of the surface acoustic wave excited in the 1st and 2nd bidirection converter parts 62a and 62b is set to v6, it is [Equation 10] like the gestalt of implementation of the above 1-4ths.
lambda5 =v5lambda6 / v6 (7)
Propagation wavelength lambda 5 of the surface acoustic wave excited in the tropism converter part 63 on the other hand so that ****** may be materialized Propagation wavelength lambda 6 of the surface acoustic wave excited in the 1st and 2nd bidirection converter parts 62a and 62b By making it different Since the center frequency of the surface acoustic wave excited in the center frequency [of a surface acoustic wave], 1st, and 2nd bidirection converter parts 62a and 62b excited in the tropism converter part 63 on the other hand can be made in agreement Maintaining the conventional advantage, while making the wave of the passage property of surface acoustic wave filter equipment into the symmetry, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it will become suitable.
[0098] Drawing 6 is the diagram-top view of the gestalt of operation of the 5th of the surface acoustic wave filter equipment by this invention. With the gestalt of this operation, it considers as the converter which shows one side of the converters of surface acoustic wave filter equipment to drawing 5 . With the gestalt of this operation, the bidirection converter of drawing 1 which forms a tropism converter on

the other hand, and is shown in drawing 5 as an input-side converter 73 is used as an output side converter 72 on a substrate 71. In addition, at the gestalt of this operation, it is the propagation wavelength of the surface acoustic wave of the input-side converter 72 and the output side converter 73 excited in a tropism converter part on the other hand lambda 7 It is the propagation wavelength of the surface acoustic wave excited in the bidirection converter part of the output side converter 73 while carrying out lambda 8 It carries out. In addition, the input-side converter 73 is equipped with a positive electrode 74 and the negative electrode 75, and the output side converter 72 is equipped with a positive electrode 76 and the negative electrode 77.

[0099] The converter shown in drawing 5 can be used as an input-side converter and an output side converter according to the bias direction of the electrode finger of a short circuit mold float electrode. That is, when the propagation of a surface acoustic wave is made to bias the electrode finger of a short circuit mold float electrode lambda7 / 12, it is used as an output side converter. When using as an input-side converter to it, it is made to bias in the direction opposite to the propagation of a surface acoustic wave lambda7 / 12.

[0100] Actuation of the gestalt of this operation is explained. the relation of a formula (7) is materialized also in the gestalt of this operation -- as -- propagation wavelength lambda 7 of the surface acoustic wave of the output side conversion 72 and the input-side converter 73 excited in a tropism converter part on the other hand Propagation wavelength lambda 8 of the surface acoustic wave excited in the bidirection converter part of the input-side converter 73 By making it different Since the center frequency of the surface acoustic wave of the output side conversion 72 and the input-side converter 73 excited in a tropism converter part on the other hand and the center frequency of the surface acoustic wave excited in the bidirection converter part of the output side converter 73 can be made in agreement Maintaining the conventional advantage, while making the wave of the passage property of surface acoustic wave filter equipment into the symmetry, also when reducing spurious one out of band effectively and designing surface acoustic wave filter equipment with steep frequency characteristics, it will become suitable.

[0101] This invention is not limited to the gestalt of the above-mentioned implementation, and many modification and deformation are possible for it. For example, although the Xtal substrate was used as a piezoelectric substrate with the gestalt of operation of the above-mentioned surface acoustic wave filter equipment 1-5ths, and the gestalt

of operation of a converter, the lithium tantalate substrate which has an electrical machinery machine coupling coefficient and a reflection property almost equivalent to the Xtal substrate other than the Xtal substrate, and a way acid lithium substrate can also be used.
[0102] Moreover, in the gestalt of the 1-4th operations, although the bidirection converter was used as an output side converter on the other hand, using a tropism converter as an input-side converter, on the other hand, a tropism converter can also be used as an output side converter, using a bidirection converter as an input-side converter.
[0103] Moreover, in the gestalt of the above 2nd and the 4th implementation, although the positive electrode was used as the 2nd electrode, using the negative electrode as the 1st electrode, the negative electrode can also be used as the 2nd electrode, using a positive electrode as the 1st electrode. In the gestalt of the 1st, 3, and operation of five, while using a positive electrode as the negative electrode, the negative electrode can also be used as a positive electrode.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the diagram-top view of the gestalt of operation of the 1st of the surface acoustic wave filter equipment by this invention.
[Drawing 2] It is the diagram-top view of the gestalt of operation of the 2nd of the surface acoustic wave filter equipment by this invention.
[Drawing 3] It is the diagram-top view of the gestalt of operation of the 3rd of the surface acoustic wave filter equipment by this invention.
[Drawing 4] It is the diagram-top view of the gestalt of operation of the 4th of the surface acoustic wave filter equipment by this invention.

[Drawing 5] It is the diagram-top view of the gestalt of operation of the surface acoustic wave converter by this invention.
[Drawing 6] It is the diagram-top view of the gestalt of operation of the 5th of the surface acoustic wave filter equipment by this invention.
[Description of Notations]
1, 21, 41, 51, 61, and 71 Xtal substrate 2, 22, 42 and 52, and 73 input-side converter -- 3 and 23 Screening electrode 4, 24, 43, 44, 53, 54, and 72 output side converter 5, 8, 25, 28, 45, 47, 49, 55, 57, 59, 64a, 64b, 64c, 74, 76 Positive electrode 6, 9, 26, 29, 46, 48, 50, 56, 58, 60, 65a, 65b, 65c, 75, and 77 negative electrode 7 66 Short circuit mold float electrode 10, 11, 12, 13, 30, 31, 32, 33 Terminal 25a, 26a, 26b Electrode finger 62a, 62b Bidirection converter part 63 On the other hand, it is a tropism converter part.

[Translation done.]

* NOTICES *

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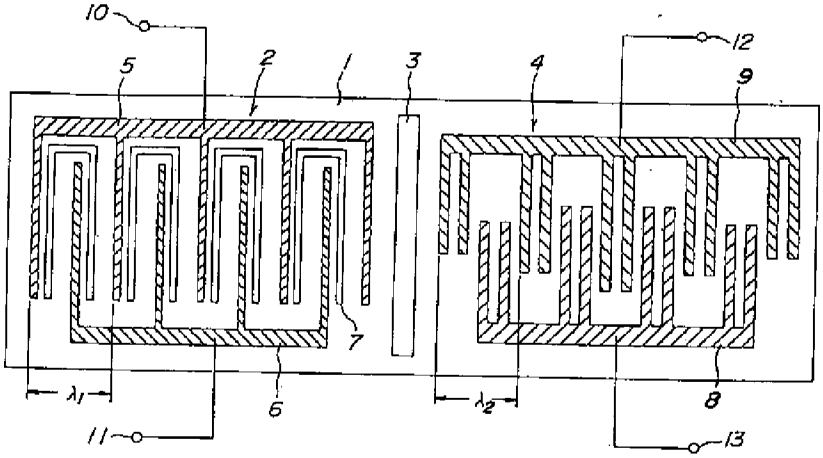
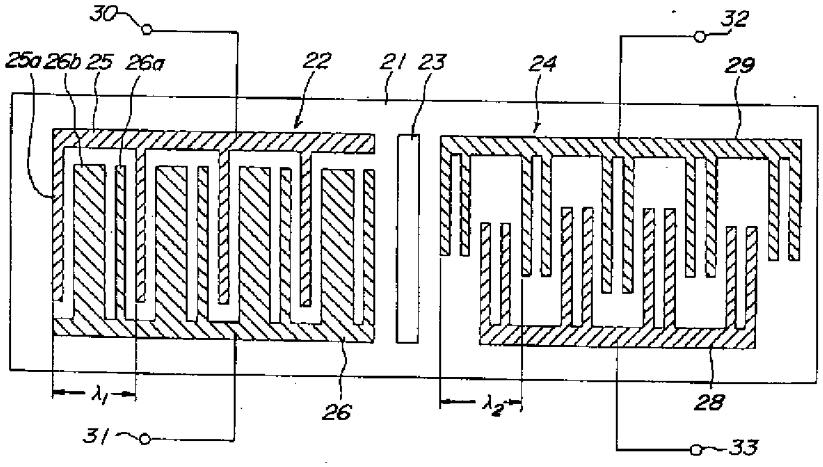
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

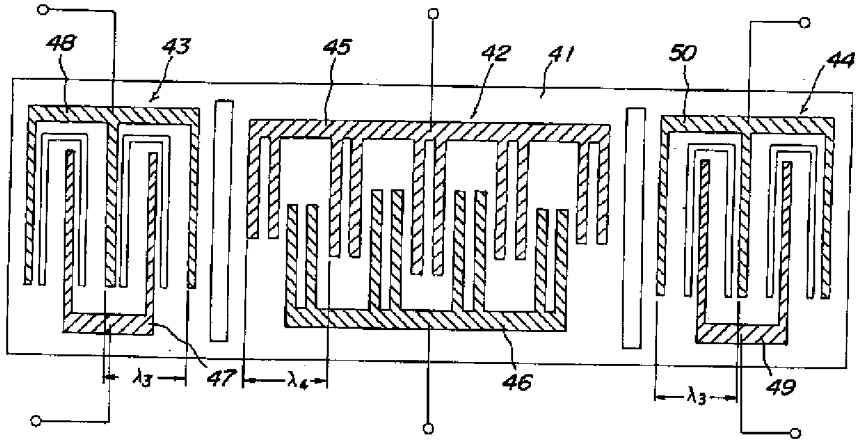
[Drawing 1]



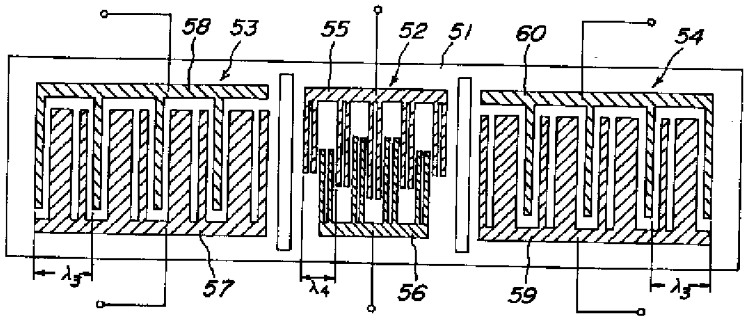
[Drawing 2]



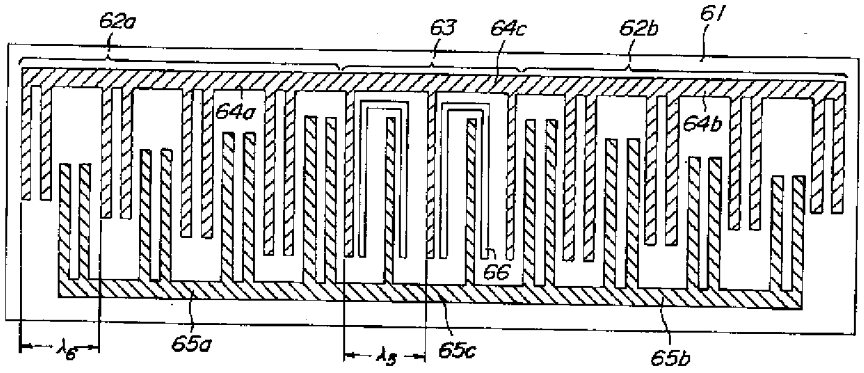
[Drawing 3]



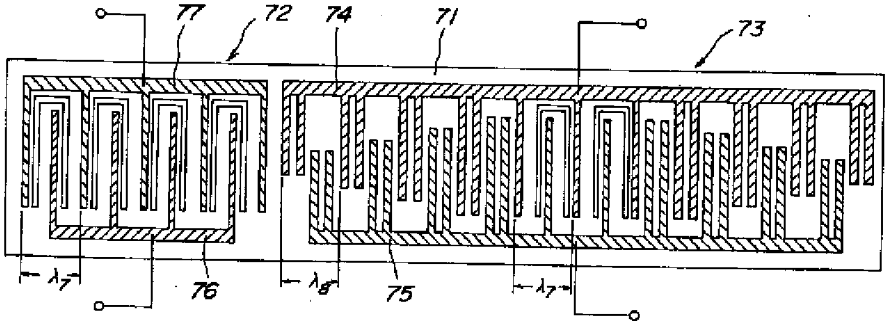
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Translation done.]